PB81-219685

# Sources of Toxic Pollutants Found in Influents to Sewage Treatment Plants
# VI. Integrated Interpresentation

(U.S.) Environmental Protection Agency
Washington, DC

Dec 79

**U.S. Department of Commerce**
**National Technical Information Service**
**NTIS**

EPA 440/4-81-008

United States
Environmental Protection
Agency

Office of Water Planning
~~and~~ Standards, Monitoring
and Support Division
Washington, DC 20460

June 1979

PB81-219685

EPA 440/4/81-008

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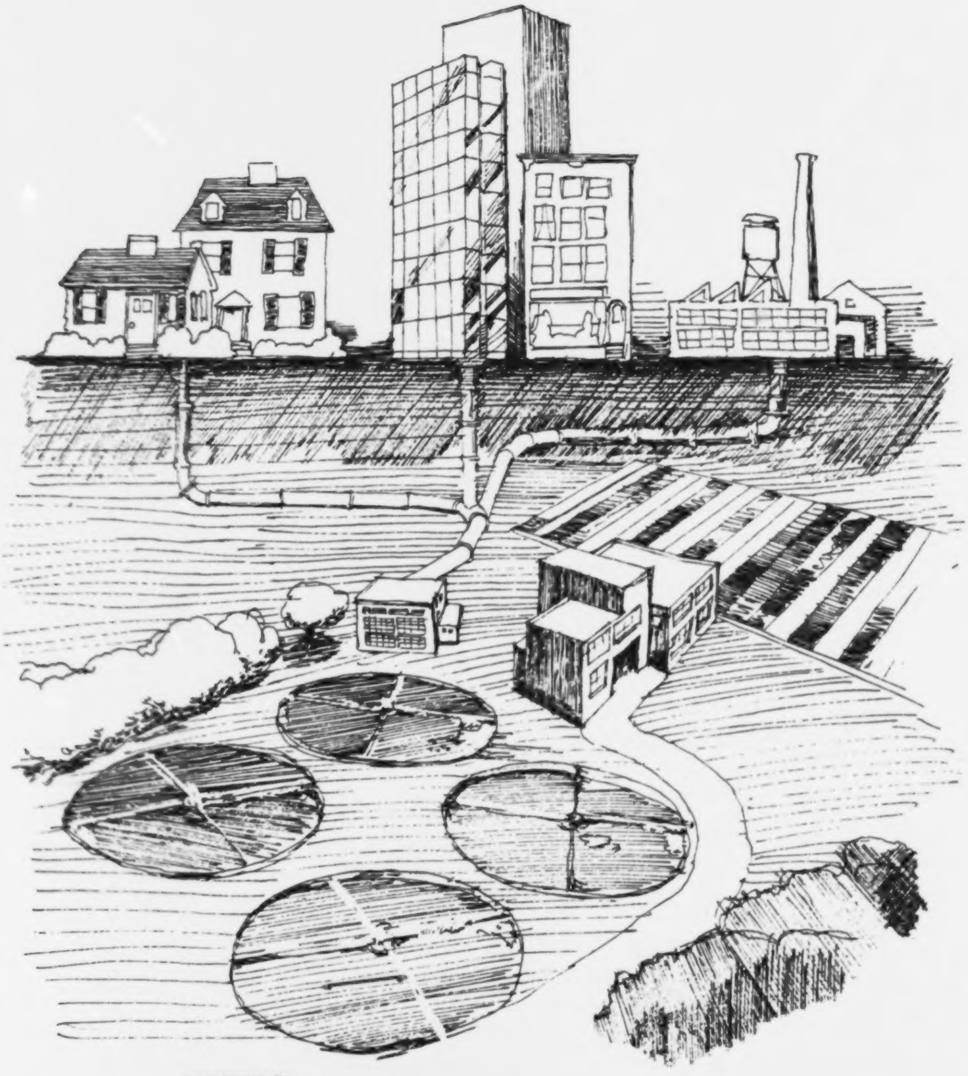
## VI. Integrated Interpresentation



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## TECHNICAL REPORT DATA
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| | | |
|---|---|---|
| 1. REPORT NO.<br>EPA 440/4-81-008 | 2. | 3. RECIPIENT'S ACCESSION NO.<br>PB81 219685 |
| 4. TITLE AND SUBTITLE<br>Sources of Toxic Pollutants Found in Influents to Sewage Treatment Plants. VI | | 5. REPORT DATE<br>January 1981<br>6. PERFORMING ORGANIZATION CODE |
| 7. AUTHOR(S)<br>P. Levins, J. Adams, P. Brenner, S. Coons<br>G. Harris, C. Jones, K. Thrun, A. Wechsler | | 8. PERFORMING ORGANIZATION REPORT NO. |
| 9. PERFORMING ORGANIZATION NAME AND ADDRESS<br>Monitoring & Data Support Division,<br>Water Quality Analysis Branch<br>U.S. Environmental Protection Agency<br>Washington, D.C. 20460 | | 10. PROGRAM ELEMENT NO.<br>(ADL 81099-63)<br>11. CONTRACT/GRANT NO.<br>68-01-3857 |
| 12. SPONSORING AGENCY NAME AND ADDRESS<br>Monitoring & Data Support Division,<br>Water Quality Analysis Branch<br>U.S. Environmental Protection Agency<br>Washington, D.C. 20460 | | 13. TYPE OF REPORT AND PERIOD COVERED<br>14. SPONSORING AGENCY CODE |
| 15. SUPPLEMENTARY NOTES | | |

16. ABSTRACT

A study has been carried out to determine the relative significance of the major sources type - residential, commercial, industrial - contributions of priority pollutants to POTW influents.

A service area in each of four cities--Cincinnati, St. Louis, Atlanta, and Hartford --has been studied in detail. In each city, specific sampling sites were selected to represent each of the major source categories. In total, 11 residential, 10 commercial and 5 industrial sites have been sampled, in addition to the tap water and POTW influents.

This report presents a summary analysis of the data made possible by integrating the results obtained from each of the cities and treating the data by source category. The data have been analyzed to determine the frequency of occurrence of toxic pollutants (specifically the list of 129 priority pollutants), their concentration levels, the sources of these pollutants, and the impact of the source contributions on the POTW influent. Manganese and several classical parameters (7XX series) were also measured and included in the data base. The analysis has been carried out within the constraints imposed by the inherent characteristics of each of the major source categories - residential, commercial, industrial - concerning the range of discharge levels which was observed for each category.

17. KEY WORDS AND DOCUMENT ANALYSIS

| a. DESCRIPTORS | b. IDENTIFIERS/OPEN ENDED TERMS | c. COSATI Field/Group |
|---|---|---|
| Pollution-Water Pollution; Quality Control; Chemistry-Inorganics Chemistry Organic, Toxic Pollutants | Environmental Data | |

| | | |
|---|---|---|
| 18. DISTRIBUTION STATEMENT<br>Release to Public | 19. SECURITY CLASS *(This Report)*<br>Unclassified | 21. NO. OF PAGES<br>125 |
| | 20. SECURITY CLASS *(This page)*<br>Unclassified | 22. PRICE |

The increase in numbers and concentration of chemicals is clear as one proceeds from tap water through residential and commercial to the industrial sources. The final result observed at the POTW influent does indeed appear to be a good integration of the individual sources values because the POTW influent concentration levels are higher than just residential values and lower than industrial values and the frequency of observation is increased in the POTW.

The relative contributions indicated in the table show clearly that the industrial sources dominate the loading on the POTW for most pollutants, but for an important number of pollutants the residential and commercial contributions are still important.

# SOURCES OF TOXIC POLLUTANTS FOUND IN INFLUENTS TO SEWAGE TREATMENT PLANTS

## VI. INTEGRATED INTERPRETATION

Report On
EPA Contract No. 68-01-3857

Mr. Donald Ehreth, Project Officer

by

P. Levins, J. Adams, P. Brenner, S. Coons,
G. Harris, C. Jones, K. Thrun, A. Wechsler

December 1979

Report No. ADL 81099-63

i.b

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# GLOSSARY

The following terms and abbreviations are used in this report.

| | |
|---|---|
| POTW | Publicly owned sewage treatment works. |
| INF<br>Influent | POTW influent. |
| Tap Water | Finished drinking water supply. |
| RES | Residential source. |
| COM | Commercial source. |
| IND | Industrial source. |
| SUM | Calculated sum of contribution for the RES, COM and IND sources. |
| SMSA | Standard metropolitan statistical area. |
| Level | Refers to concentration level of pollutants. |
| Classicals | The six conventionally measured parameters: ammonia, oil and grease, total suspended solids (TSS), total organic carbon (TOC), chemical oxygen demand (COD) and biological oxygen demand (BOD). The classicals were always measured in mg/L units in contrast to the toxic pollutant measurements in ug/L units. |
| Pollutant Reference Numbers | A series of reference numbers were assigned to the pollutants for convenience in data storage and retrieval as follows: |
| 1XX | Volatiles analysis category. |
| 2XX | Acids analysis category. |
| 3XX | Base/Neutral analysis category. |
| 4XX | Pesticides and PCB analysis category. |
| 5XX | Metals analysis category. |
| 6XX | Total cyanide and total phenols. |
| 7XX | Classicals. |
| ug | Microgram. |
| mg | Milligram. |
| Kg | Kilogram. |
| ug/L | Concentration in micrograms per liter. |
| mg/L | Concentration in milligrams per liter. |
| Lps | Flow rate in liters per second. |
| MGD | Flow rate in million gallons per day. |
| QA | Quality assurance. |
| QC | Quality control. |

# ACKNOWLEDGMENTS

We wish to acknowledge the considerable efforts and cooperation of the many people whose contribution helped in the successful completion of the work described in this report.

This study was sponsored by the Monitoring and Data Support Division (MDSD) of the Office of Water Planning and Standards; Mr. Donald Ehreth, Project Officer. The study was directed by Mr. Michael A. Callahan and Mr. Richard Seraydarian whose guidance was significant in formulating the approach for this work. The contributions of Mr. Rod Frederick of MDSD and Mr. Thomas O'Farrell of the Office Staff are also acknowledged.

The cooperation of the personnel at each municipality was invaluable in designing the field plan and obtaining the other supporting data for this study.

We wish particularly to thank the large number of Arthur D. Little, Inc. staff members who participated in the sampling and analysis team efforts. Their commitment to the program and their extra hours effort helped make the study a success. The willing cooperation of the corporate facilities staff also helped considerably with the intense start-up effort required for this study.

# I. SUMMARY

A study has been carried out to determine the relative significance of the major source type - residential, commercial, industrial - contributions of priority pollutants to POTW[*] influents.

A service area in each of four cities--Cincinnati, St. Louis Atlanta and Hartford--has been studied in detail. In each city, specific sampling sites were selected to represent each of the major source categories. In total, 11 residential, 10 commercial and 5 industrial sites have been sampled, in addition to the tap water and POTW influents.

This report presents a summary analysis of the data made possible by integrating the results obtained from each of the cities and treating the data by source category. The data have been analyzed to determine the frequency of occurrence of toxic pollutants (specifically the list of 129 priority pollutants), their concentration levels, the sources of these pollutants, and the impact of the source contributions on the POTW influent. Manganese and several classical parameters (7XX series) were also measured and included in the data base. The analysis has been carried out within the constraints imposed by the inherent characteristics of each of the major source categories - residential, commercial, industrial - concerning the range of discharge levels which was observed for each category.

The data available for analysis consist primarily of three types:

1. Total service area source type description and demography and similar data for each specific sampling site.
2. Entire service area and site specific flow data.
3. Chemical concentration data.

The general source descriptions and details of housing, population, SIC category industries, etc. was obtained from local agencies in each of the four cities studied. Flow information for the commercial and industrial users in the entire service area was obtained from the water supply records.

---

[*] Publicly Owned Treatment Works

Field sampling at each site occurred over a period of six days, resulting in 30-60 24-hour or 48-hour composite samples per city.

Flows were measured at each site for use in calculating mass discharge rates. Each of the samples was returned to the laboratory for complete chemical analysis according to the EPA protocol.

A full quality control program was implemented for the chemical analyses. The results of this program showed that most pollutants were analyzed with 80-90% accuracy and with a relative standard deviation of 10-30%.

The available data have been grouped according to the major source categories. For each category, the frequency of detection of a given pollutant and its average concentration has been determined. For residential sources, the per capita discharge rate (mg/person/day) has been calculated for each site and each pollutant. An average index value has been calculated for each source category such that, when the quantity of each source type was known, the POTW influent mass flow could be calculated from

$$\text{POTW (Kg/day)} = V_R A_R + V_C A_C + A_I A_I$$

where V is the index value for each source type (R = residential, C = commercial, I = industrial) and A is the amount of source activity. For the residential sources, the population was used as an index base. For the commercial and industrial soruces, the total source type flow was used as the base. The indices calculated using this approach appear to be reliable for the residential and commercial sources, but can only be used as estimates for the industrial sources, because of the highly specific dependence of this index on industry type. The industrial index has been useful primarily for purposes of comparison with the other two source types. Perhaps the most important observation in this study is that relatively few toxic pollutants were found in the sources and many of those found were present at low concentration levels. A total of 56 priority pollutants were observed in this study, grouped as indicated below by analysis category:

| | |
|---|---|
| Volatiles | 24 |
| Acids | 7 |
| Base/Neutrals | 11 |
| Pesticides | 2 |
| Metals | 12 (plus manganese) |
| Total Cyanides | |
| Total Phenols | |

The pollutants given in Table 1 were never detected (within the limits of the chemical analysis) during the entire study.

The following 5 box plots (Figures 1-5) show the frequency of detection and the average source concentration values for pollutants which were observed more than 50% of the time and/or at source average concentrations greater than 10 µg/L. The data have been grouped according to those chemicals observed at levels less than 10 µg/L, 10-100 µg/L.

The increase in numbers and concentration of chemicals is clear as one proceeds from tap water through residential and commercial to the industrial sources. The final result observed at the POTW influent does indeed appear to be a good integration of the individual source values because the POTW influent concentration levels are higher than just residential values and lower than industrial values and the requency of observation is increased at the POTW.

The data in Figures 1-5 relate to concentration only and cannot be used directly for projection to other areas.

In order to evaluate the potential impact of the individual source type contributions on the POTW, the average index values for each type were scaled by the flow (or population) for that source to calculate typical POTW loadings. The example in Table 2 shows the fraction contributed from each source type resulting in the indicated POTW loading (in Kg/day) for a hypothetical city whose characteristics were as follows:

## Table 1

### Pollutants (67 Total) Never Detected in Four Cities

| | |
|---|---|
| *101 | Chloromethane |
| 102 | Dichlorodifluoromethane |
| 103 | Bromomethane |
| 107 | Acrolein |
| 122 | Cis-1,3-dichloropropylene |
| 202 | Nitrophenol |
| 208 | 2,4-dinitrophenol |
| 209 | 4,6-dinitro-2-cresol |
| 211 | 4-Nitrophenol |
| 304 | Hexachloroethane |
| 305 | Bis(chloromethyl)ether |
| 306 | Bis(2-chloroethyl)ether |
| 307 | Bis(2-chloroisopropyl)ether |
| 308 | N-Nitrosodimethylamine |
| 309 | Nitrosodi-n-propylamine |
| 311 | Hexachlorobutadiene |
| 313 | 2-Chloroethyl vinyl ether |
| 314 | Bis(2-chloroethoxy)methane |
| 316 | Isophorone |
| 317 | Hexachlorocyclopentadiene |
| 318 | 2-Chloronaphthalene |
| 319 | Acenaphthylene |
| 320 | Acenaphthene |
| 321 | Dimethyl phthalate |
| 322 | 2,6-Dinitrotoluene |
| 323 | 4-Chlorophenyl phenyl ether |
| 324 | Fluorene |
| 325 | 2,4-Dinitrotoluene |
| 327 | 1,2-Diphenylhydrazine |
| 328 | N-Nitrosodiphenylamine |
| 329 | Hexachlorobenzene |
| 330 | 4-Bromophenyl phenyl ether |
| 336 | Benzidine |
| 340 | Chrysene/Benzo(a)anthracene |
| 342 | 3,3'-Dichlorobenzidine |
| 343 | Benzofluoranthenes** |
| 345 | Benzo(a)pyrene |
| 346 | Indeno (1,2,3-c,d)pyrene |
| 347 | Dibenzo(a,h)Anthracene |
| 348 | Benzo(g,h,i)perylene |
| 349 | TCDD |
| 401 | alpha-BHC |
| 402 | gamma-BHC |
| 403 | beta-BHC |
| 405 | delta-BHC |
| 407 | Heptachlor epoxide |
| 408 | Endosulfan I. |
| 409 | DDE |
| 410 | Dieldrin |
| 411 | Endrin |
| 412 | DDD |
| 413 | Endosulfan II. |
| 414 | DDT |
| 415 | Endrin aldehyde |
| 416 | Endosulfan sulfate |
| 417 | Chlordane |
| 418 | Toxaphene |
| 419 | PCB-1221 |
| 420 | PCB-1232 |
| 421 | PCB-1242 |
| 422 | PCB-1248 |
| 423 | PCB-1254 |
| 424 | PCB-1260 |
| 425 | PCB-1016 |
| 503 | Beryllium |

*The 101, etc., numbers paired with pollutants are referencing numbers for data storage.

**Two compounds.

|  | Less Than 50% | Greater Than 50% |
|---|---|---|
| Greater Than 100 µg/L |  |  |
| Between 10 µg/L and 100 µg/L | Lead | Chloroform<br>Zinc<br>Copper |
| Less Than 10 µg/L | (All others detected) | Bromodichloromethane<br>Dibromochloromethane<br>Manganese |

Figure 1: Concentration/Frequency of Occurrence: Tap Water

| | Less Than 50% | Greater Than 50% |
|---|---|---|
| Greater Than 100 µg/L | | Zinc<br>Manganese |
| Between 10 µg/L and 100 µg/L | | Lead<br>Copper<br>Chromium<br>Total Phenols |
| Less Than 10 µg/L | (All others detected) | Chloroform<br>1,1,2,2-Tetrachloroethylene<br>Toluene<br>Nickel<br>Selenium |

Figure 2: Concentration/Frequency of Occurrence: Residential

|  | Less Than 50% | Greater Than 50% |
|---|---|---|
| Greater Than 100 µg/L |  | Manganese<br>Zinc |
| Between 10 µg/L and 100 µg/L | Trichloroethylene<br>Di-n-butylphthalate | 1,1,2,2-Tetrachloroethylene<br>Toluene<br>Butylbenzylphthalate<br>Copper<br>Lead<br>Chromium<br>Nickel<br>Total Phenols |
| Less Than 10 µg/L | (All others detected) | Chloroform<br>Bromodichloromethane<br>1,1,1-Trichloroethane<br>Benzene<br>Ethylbenzene<br>Silver |

Figure 3: Concentration/Frequency of Occurrence: Commercial

|  | Less Than 50% | Greater Than 50% |
|---|---|---|
| Greater Than 100 µg/L |  | Ethylbenzene<br>Phenol<br>Dichlorobenzenes<br>Butylbenzylphthalate<br>Silver<br>Copper<br>Nickel<br>Chromium<br>Lead<br>Manganese<br>Zinc<br>Total Phenols |
| Between 10 µg/L and 100 µg/L | 1,1-Dichloroethylene<br>Trans-1,2-dichloroethylene<br>Carbon Tetrachloride<br>2,4-Dimethylphenol<br>Pentachlorophenol<br>Bis(2-ethylhexyl)phthalate<br>Cadmium | Chloroform<br>Trichloroethylene<br>1,1,1-Trichloroethane<br>1,1,2,2-Tetrachloroethylene<br>Toluene<br>Naphthalene<br>Di-n-butylphthalate<br>Total Cyanides |
| Less Than 10 µg/L | (All others detected) | Benzene<br>Bromodichloromethane<br>Dibromochloromethane<br>Antimony |

Figure 4: Concentration/Frequency of Occurrence: Industrial

| | Less Than 50% | Greater Than 50% |
|---|---|---|
| Greater Than 100 µg/L | | Chromium<br>Manganese<br>Zinc |
| Between 10 µg/L and 100 µg/L | Naphthalene<br>Butylbenzylphthalate<br><br>Antimony | Trichloroethylene<br>1,1,1-Trichloroethane<br>1,1,2,2-Tetrachloroethylene<br>Toluene<br>Ethylbenzene<br>Dichlorobenzenes<br><br>Copper<br>Lead<br>Nickel<br><br>Total Cyanides<br>Total Phenols |
| Less Than 10 µg/L | (All Others Detected) | Chloroform<br>Benzene<br>Diethylphthalate<br>Di-n-butylphthalate<br><br>Cadmium<br>Silver |

Figure 5: Concentration/Frequency of Occurrence: POTW Influent

## Table 2

### Hypothetical Drainage Basin Calculation

### (Flow 60% Residential, 20% commercial, 20% Industrial)

| | Relative Fraction | | | SUM |
|---|---|---|---|---|
| | RES | COM | IND | Kg/day* |
| 110 1,1-DICHLOROETHYLENE | .00 | .02 | .98 | .30 |
| 111 1,1-DICHLOROETHANE | .00 | .03 | .97 | .04 |
| 112 TRANS-1,2-DICHLOROETHYLENE | .00 | .08 | .92 | .33 |
| 113 CHLOROFORM | .34 | .18 | .48 | .65 |
| 114 1,2-DICHLOROETHANE | .08 | .12 | .90 | .02 |
| 115 1,1,1-TRICHLOROETHANE | .03 | .02 | .95 | 2.32 |
| 116 CARBON TETRACHLORIDE | .00 | .00 | 1.00 | .74 |
| 117 BROMODICHLOROMETHANE | .06 | .28 | .67 | .06 |
| 120 TRICHLOROETHYLENE | .06 | .24 | .70 | .94 |
| 121 BENZENE | .15 | .50 | .35 | .09 |
| 123 DIBROMOCHLOROMETHANE | .05 | .28 | .67 | .04 |
| 125 BROMOFORM | .00 | .00 | .00 | .00 |
| 127 1,1,2,2-TETRACHLOROETHYLENE | .18 | .14 | .68 | 2.66 |
| 128 TOLUENE | .12 | .11 | .77 | 1.76 |
| 129 CHLOROBENZENE | .17 | .02 | .81 | .03 |
| 130 ETHYL BENZENE | .01 | .02 | .97 | 2.69 |
| 203 PHENOL | .17 | .02 | .82 | 4.31 |
| 204 2,4-DIMETHYLPHENOL | .02 | .00 | .98 | 1.96 |
| 210 PENTACHLOROPHENOL | .35 | .18 | .47 | .55 |
| 301 DICHLOROBENZENES | .02 | .01 | .97 | 10.05 |
| 315 NAPHTHALENE | .05 | .03 | .92 | 1.43 |
| 326 DIETHYL PHTHALATE | .93 | .07 | .00 | 1.44 |
| 333 DI-N-BUTYL PHTHALATE | .34 | .07 | .59 | 2.95 |
| 337 BUTYL BENZYL PHTHALATE | .12 | .04 | .85 | 5.15 |
| 338 BIS(2-ETHYLHEXYL)PHTHALATE | .32 | .07 | .61 | 1.86 |
| 501 ANTIMONY | .83 | .02 | .15 | .29 |
| 502 ARSENIC | .86 | .05 | .09 | .94 |
| 504 CADMIUM | .07 | .02 | .91 | .59 |
| 505 CHROMIUM | .06 | .05 | .89 | 20.80 |
| 506 COPPER | .63 | .08 | .29 | 11.23 |
| 507 LEAD | .32 | .06 | .61 | 13.66 |
| 508 MANGANESE | .55 | .18 | .27 | 21.97 |
| 509 MERCURY | .34 | .08 | .58 | .08 |
| 510 NICKEL | .09 | .06 | .85 | 3.33 |
| 511 SELENIUM | .83 | .12 | .05 | .46 |
| 512 SILVER | .06 | .01 | .93 | 4.20 |
| 513 THALLIUM | .00 | .49 | .51 | .00 |
| 514 ZINC | .35 | .06 | .59 | 37.81 |
| 601 TOTAL CYANIDES | .06 | .00 | .94 | 2.51 |
| 602 TOTAL PHENOLS | .33 | .07 | .59 | 8.91 |
| 703 AMMONIA | .77 | .09 | .14 | 2.02 |
| 704 OIL AND GREASE | .53 | .19 | .28 | 9.81 |
| 705 TSS | .66 | .09 | .25 | 22.65 |
| 706 TOC | .59 | .14 | .26 | 12.85 |
| 707 COD | .57 | .13 | .30 | 46.05 |
| 708 BOD | .56 | .14 | .29 | 19.21 |

*Classicals (7XX) in $10^3$ kg/day.

| | |
|---|---|
| POTW Influent Flow: | 1,000 Lps (Liters per second) |
| Residential - Flow: | 600 Lps |
| - population | 136,500 People |
| Commercial Flow: | 200 Lps |
| Industrial Flow: | 200 Lps |

Although this example is just for a hypothetical city, the relative flow contributions chosen for each source type approximates the actual average values for 327 larger drainage basins with POTWs having secondary treatment.

The relative contributions indicated in the table show clearly that the industrial sources dominate the loading on the POTW for most pollutants, but, for an important number of pollutants the residential and commercial contributions are still important. In interpreting these results one should remember that the industrial component is quite industry specific and the industrial contribution could be higher or lower depending on the particular industries present. This example represents one way in which the data contained in this report may be used to evaluate the importance of source strengths on POTW influent toxic pollutant burden.

Several other factors are evident in examination of the data. Toxic pollutants are found slightly more frequently on weekdays than weekends. There is a higher per capita pollutant load from old versus new residential areas, especially for lead and phenol. There is a high degree of correlation in the amounts of aliphatic and aromatic hydrocarbons found in the samples. The quantities of aromatic hydrocarbons show similar trends and frequently follow the quantities of a number of other pollutants. The quantities of lead and zinc trend in the same manner.

For the limited rain event data collected in this study, the lead, zinc and manganese levels were observed to increase during the rain.

## II. INTRODUCTION

It is the concern of the Office of Water Planning and Standards (OWPS) to develop a comprehensive strategy governing the toxic substances introduced into, and subsequently passing through, the publicly-owned sewage treatment works (POTWs). In order to supply the necessary basis for formulating guidelines, the Monitoring and Data Support Division (MDSD) has sponsored this study of cities across the country. In addition to assessing the extent to which priority pollutants may enter the environment via the POTWs, this POTW program is concerned with determining the sources of those pollutants. The objectives of the POTW source survey include defining the various types of source categories, describing those categories in terms of priority pollutant contributions, and determining the relationship of the individual source measurements to the pollutant burden at the POTW influent.

By using the data to calculate a set of pollutant specific indices corresponding to the residential, commercial and, to a lesser extent, industrial sources for each of the cities sampled, it is hoped that a general characterization of the pollutant load attributable to these categories can be made. In this way, the sources of the pollutants measured in the POTW influent of previously unsampled treatment basins may be estimated in such a way as to suggest valid routes to limit pollutant loads.

The details of the studies carried out in this program have been published in five preceeding reports(1-5). The sampling and analysis procedures employed in the POTW source survey were those outlined in the EPA Screening Protocol for Priority Pollutants[6]. A detailed quality control program was implemented for this study patterned after the EPA recommendations of a QC program for verification studies[7]. The data given in the individual city reports showed the analyses to be in control with respect to producing reliable concentration data, free from interference. The QC program also made it possible to consistently achieve low detection limits for the toxic pollutants.

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A limited attempt had been made in each of the individual city reports to compare the importance of source types on the POTW burden. This report integrates the data from each of the individual studies, by source type, for a more comprehensive and reliable analysis of each of the factors which were goals of the study.

There were many objectives in this study, but of fundamental importance was the desire to determine which pollutants were present in sources (and which were not) at what frequency and the relative mass contribution of each source type for each pollutant. If possible, it was desirable to establish a discharge index for at least the residential and commercial source types so that their impact on the POTW could be compared to that of the industrial sources.

Other objectives included examining variances within and between source types: weekday/weekend effects, chemical to chemical correlations, etc. Some of these objectives could be addressed during this study, many of the other secondary objectives will require further study.

The overall approach used in the study was to collect specific mass discharge rate data (calculated from measured concentration and flow values) from a number of specific sites representing residential, commercial and, to a lesser extent, industrial sites. The methdology involved going to several cities and sampling portions of each source type in each city (when possible, depending on the city characteristics) such that the desired data base would be available after all of the cities had been sampled. Because of the high cost and considerable time associated with completing the study of a single city, it has only been possible to sample four cities. The cities, and drainage basins within the cities, were selected in an effort to reasonably reflect each of the major source types. It is felt that the residential and commercial sources are well represented in the data base in terms of overall POTW activity. It is also recognized that the industrial source data base is much more restricted in terms of overall representatives. While the conclusions which can be drawn from such a limited data base are tentative, it is believed that the data summarized in this report provide a reliable base for future evaluations.

The individual city reports contain a great deal of information about the site and service area descriptions, the sampling and analysis procedures and detailed results. The purpose of this report is to summarize essential portions of the data in those reports in order to be able to interpret the total data base in terms of each of the objectives.

# III. METHODOLOGY DATA BASE

## A. Drainage Basin Selection Criteria

Selection of specific service areas (drainage basins) and sampling sites within the areas that meet all of the program goals turned out to be a much more difficult problem than had originally been anticipated. The criteria used in the selection process and the factors influencing the final decisions are described briefly in this section.

At the outset of this study, three constraints were imposed upon site selection:

1) Only those plants employing secondary or better treatment technology were to be considered;
2) Only plants with average daily influent flows greater than or equal to 5.0 MGD were to be considered; and
3) Only those treatment facilities located within standard metropolitan statistical areas (SMSA's) were to be considered.

The reasons for setting these original constraints were that

1) Secondary treatment technology or better would be mandated by 1983 under the provisions of the Clean Water Act;
2) The impact of large flow variability is not as great as plant size increases;
3) The variety and amount of industrial activity frequently increases as plant size increases;
4) The sampling process would not interfere with normal operations in larger plants;
5) Most industrial activity occurs within SMSA's, urban treatment facilities have a larger variety of industrial dischargers than do rural POTW's.

In preparation for this study, EPA had (through its contractor, SRI International) formed a data base of 25,076 POTWs based upon information supplied in the 1976 Needs Survey. From that base, a subset of

324 plants with secondary treatment was selected for consideration. A further reduced list of 80 plants was constructed by random selection from the 324 plant list. That list of 80 plants represented the starting point for site selection for this study.

Some problems arose, however, in attempting to use only the "80" list for site selection. While the concept of multivariate regression analysis and random selection (used in developing the list of 80 plants) would have lent statistical credibility to the ultimate site selection process, such an approach must be founded upon a good data base. Subsequent to contacting several of the facilities identified on the list, it was learned that many plants in fact only had primary treatment. Similarly it was learned that many secondary plants that were desirable for this study's needs had been missed during the analysis because data obtained from the 1976 Needs Survey was incorrect. Therefore, the 80 and 324 lists were frequently used only as a first reference. Additional data was obtained from other sources (water pollution control federations, state departments of environmental protection, telephone conversations with sewage treatment authorities, etc.) to supplement these lists.

The process of screening the remaining POTW's was conducted by placing telephone calls to a number of candidate facilities, and by obtaining as much additional information about each as was possible. After completing this series of calls, all the additional data was reviewed prior to selecting two or three which were then visited. Once site visits had been completed the final selection of a test facility was made. This process was repeated for each city.

Specific issues examined during the screening selection process phase included:

- Geographic location of the facility
- Plant and drainage basin size
- Identification of proper sampling zones
- Availability of background information
- Availability of maps
- Convenience of the city, both with respect to internal

congestion and with respect to sample shipment
- Logistics support available within the area
- The perceived safety and accessibility of the sampling area, and
- The willingness of the local authorities to participate and assist with the study.

Prior to final site selection, initial contacts were made both over the telephone and during preliminary meetings to accumulate as much information as was possible.

Plant and basin size were important considerations because each appeared to have a bearing upon the diversity of socio-economic activity that existed within an area. As was learned early in this program, plants with small daily influent flows (5 to 10 MGD) were frequently located in areas where only one type of activity was present. For example, many of the basins that exhibited low influent rates (5 - 10 MGD) were comprised of virtually all (90-95%) residential activity, with very little (5-10%) commercial activity and almost no industrial component (0-1%). Conversely, one plant with an average daily influent of 12 MGD had a flow mix which was nearly 99% industrial. Any of these plants would have been acceptable if the project's goals were only to assess one source's contributions independent of the others; but inasmuch as an assessment of all three was desired concurrently, these types of sites were excluded from further consideration.

A second problem encountered in several of the smaller service areas (with respect to the area served) was that even when a basin was identified which contained all three activities (residential, commercial and industrial), it was frequently impossible to isolate these activities in the collection system. This difficulty usually arose because the smaller basins were frequently interconnected by single interceptors, where wastewater from one activity would drain through another, prior to reaching the POTW.

The identification of proper sampling zones was also considered to be important. Since the final goal of this study was to enumerate the pollution burden of at least two socio-economic activities at a minimum in each basin, areas typifying both of these had to be identified, and segregated if possible. It was desirable to locate duplicate areas within a basin because this allowed for an immediate confirmation of results under conditions that were equivalent.

Another factor considered important to the selection of a test facility related to the availability of background or supportive data. Of particular importance was the availability of demographic information which is needed to describe the activity within the particular sampling zones selected and within the basin as a whole. However, supplementary data, such as 201 and 208 studies, facility plans, and inflow/infiltration assessment were also valuable.

Similarly, it was essential that the identified facility have detail or cadastral maps of the collection system. Without having access to these maps, it is virtually impossible to select appropriate sampling locations because the area drained cannot be outlined.

The geographic location of the facility was also used as a criteria in the selection process. Although one reason for including this issue pertained to the climate of the area during the analysis period, the main reason for considering it related to the issues of the variability of groundwater and soil chemistry across the country. Initially these factors were believed to have some possible bearing upon the distribution or fate of the priority pollutants within the collection system. For example, the pH of water (either drinking or groundwater) could influence the partitioning of organic acids and bases between the sediment, aqueous or gaseous phase. Comparably, interactions (particularly adsorption) between the priority pollutants and soil types could have an affect on measured concentrations.

To address this issue, the country was divided into seven regions based upon three factors:

1) Water chemistry as defined by the presence of anions such as $Cl^-$, $SO_4^=$, and $CO_3^=$,
2) The ionic strength of the water as defined by the concentration of dissolved minerals, and
3) A comparison of soil types.

The initial goal was to select at least one test facility from each zone. Program constraints and the difficulty in locating areas which met all of the needs of the study resulted in the study of basins in three of the seven zones. One zone represented about 50 percent of the area of the Continental United States and the Cincinnati and St. Louis sites were in this zone.

Other factors which also influenced the basin selection related to logistical concerns. Some of the key factors considered at this juncture included the congestion of the area, as this related directly to the ability to maintain a four-hour rotation between all the remote sites; the proximity of a major airport, as this affected the shipment of samples back to the laboratory; and the availability of rental vehicles (trucks, automobiles, trailers) and supplies.

## B. Drainage Basins Selected for Study

Four drainage basins have been sampled for this study. They are:

Muddy Creek Drainage Basin, Cincinnati, Ohio
Coldwater Creek Drainage Basin, St. Louis, Missouri
R. M. Clayton Drainage Basin, Atlanta, Georgia
Hartford WPCP Drainage Basin, Hartford, Connecticut

Detailed descriptions of each basin are given in the individual reports. A brief description of each basin is given here in order to help provide a perspective on the source character and mix of each of the areas.

### 1. Muddy Creek Drainage Basin, Cincinnati, Ohio

The Muddy Creek drainage basin is located in the western portion of of the greater Cincinnati, Ohio metropolitan area. It is bounded to the south by the Ohio River, to the west by the Ohio/Indiana state line and to the north by I-74. The drainage basin is roughly 29 square miles in size and has a population of approximately 88,000. Contained within this area are newer housing developments, older residential communities, recreational areas, shopping centers and commercial districts, a small amount of industrial activity and a fair amount of open space or land currently undergoing development. Generally, the area may best be described as "suburban Cincinnati."

Major communities included in part or in total within the basin are Cincinnati, Cheviot, Addyston, Green Township, Miami Township and Delhi Township. Of these, the areas of Cincinnati, Cheviot, and Addyston are older (circa pre-1940). The three township areas are generally more open, but have been the location of recent developments.

Based upon estimates derived from a theoretical flow analysis of the basin, the blend of activity contained within the area is 90-92% residential, 7-9% commercial and 0-1% industrial. The average daily influent to the treatment plant is 9.5 million gallons. The collection system is a combination of both sanitary and combined sewers.

### 2. Coldwater Creek Drainage Basin, St. Louis, Missouri

The Coldwater Creek drainage basin lies to the north and west of the City of St. Louis, Missouri. None of the City of St. Louis is located within the area of the basin; however, all of the basin is located within St. Louis County. The basin is bordered to the north and west by the Missouri River, open land, and the community of Bridgeton; to the east by several communities contained within St. Louis County (Ferguson, Belridge); and to the south by the community of Olivette. Part or all of fifteen communities are contained within the basin, including Florissant, Berkeley and St. Ann. The total land mass of the drainage area encompasses approximately 34-36 square miles. The population of this area is estimated to be roughly 200,000.

Socio-economic activity contained within this area includes older residential which is concentrated along the southern and eastern borders and newer residential, predominently along the northern and northwestern borders. Furthermore, high density strip commercial zones are found running north to south along Lindbergh Boulevard and east to west along

St. Charles Rock Road. The largest shopping center is situated at the intersection of these two roads. Industrial activity is concentrated near the center of the basin, just north of Lambert Airport. Major industrial activities include an aircraft manufacturer, two automobile assembly or part facilities and a diesel engine (railroad) assembly plant.

Based upon estimates obtained from the theoretical flow analysis of the basin, the wastewater tributary to the Coldwater Creek Plant is comprised of roughly 78% residential, 10% commercial and 12% industrial flow. The treatment plant has an average daily influent flow of roughly 23.5 MGD and uses the activated sludge technology for wastewater cleanup. The collection system is sanitary only, with storm water being channeled directly to the numerous creeks within the basin.

### 3. The R. M. Clayton Drainage Basin, Atlanta, Georgia

The R. M. Clayton drainage basin is located in the metropolitan Atlanta, Georgia area. The overall size of the basin is approximately 130-140 square miles and the estimated population is roughly 385,000. With the exception of being bordered on the west by the Chattahcochee River, no well defined borders exist to describe the area. However, the basin encompasses most of the northern part of the City of Atlanta, the southern portion of Fulton County, a large amount of the mid-section of DeKalb County and a small amount of southwestern Gwinett County.

A rough breakdown of the distribution of land from each of these areas is listed below:

| | |
|---|---|
| City of Atlanta | 45-50 square miles |
| Fulton County | 20-25 square miles |
| DeKalb County | 60-65 square miles |
| Gwinett County | 5-10 square miles |

The breakdown of socio-economic activity within the area indicates that there are many industrial parks scattered throughout the basin. Two of these are reasonably large: one situated along the southwestern border of the basin near the river, and the second located in

DeKalb County near the intersections of I-285 and the Buford Highway. Major industrial complexes contained in the basin include an automotive assembly plant, a steel mill, paint manufacturers and industrial laundries. Similarly, commercial activity is scattered throughout the basin. However, of these zones, the most extensive is concentrated in "downtown" Atlanta. Residential activity includes all strata of the economic spectrum. Typically, the older residential areas are most concentrated in or near the city limits, while the newer areas are found near the northern and eastern edges of the basin in both Fulton and Gwinett counties. Also included within the basin is a large amount of institutional (colleges, universities, hospitals, etc.) and municipal activity, as well as open space.

Based upon theoretical flow estimates, the blend of activity within the R. M. Clayton basin is roughly 61% residential, 21% commercial and 18% industrial. The average daily influent flow to the treatment plant is 80 MGD, and the treatment technology used is activated sludge. The collection system contains both combined and sanitary sections, with all of the combined lines being present within the Atlanta city limits.

### 4. Hartford WPCP Drainage Basin, Hartford, Connecticut

The Hartford Water Pollution Control Plant's drainage basin is located in the greater Hartford, Connecticut metropolitan area. Portions of six communities (Hartford, Wethersfield, Newington, West Hartford, Bloomfield and Windsor) are served by the plant. The basin itself covers approximately 60-65 square miles of area and the current population is estimated to be 285,000. The basin is bordered on the east by the Connecticut River, on the west by the communities of Farmington and Avon, to the south by the community of Rocky Hill and to the north by East Granby.

The major activities present within the basin are principally residential and commercial, although a small industrial component is also included. Typically, older residential activity is concentrated in the City of Hartford, Wethersfield and Windsor, with newer residential areas located principally in the community of Bloomfield. The major commercial district is in downtown Hartford. This area is comprised of both retail businesses and office building activity. The main commercial interest within this basin is insurance. The industrial component contained in the basin is scattered throughout the area. This activity is principally light in nature (warehousing, supply companies) although a number of tool and die shops, metal fabricators and platers are also included. Municipal activities also abound as Hartford is the State Capital of Connecticut.

Based upon flow estimates derived from a theoretical analysis, the breakdown by activity of this basin is 72% residential, 21% commercial, and 7% industrial. The average daily influent to the plant is 40-44 MGD. Once again, the collection system is comprised of both sanitary and combined sewers.

### 5. Summary of Source Characteristics

All of the data from the four cities was organized by source category. Table 3 lists the sites in each source category and their basic characteristics. The entire group of residential sources has been treated as one category for the majority of the analyses. Both old and new residential sites were sampled and some differences were seen between these subsets, but the information on the relative amounts of each of these sub categories was not available for the entire service area.

In addition to these sites, four sites were sampled but not used in the overall analysis because they were of mixed source character. They were Sylved and St. George (a hospital) in Cincinnati, Wabash in St. Louis, and Peachtree in Atlanta. Of course, the POTW influent was sampled in each city as well as the tap water. In St. Louis, both the influent and the effluent of the POTW were sampled and an analysis of treatment efficiency is given in the St. Louis report.

## C. Demographic and Economic Data

An important aspect of the field sampling program was to obtain demographic and economic data needed to characterize the entire POTW treatment area as well as the individual sampling sites. This information was important in describing the sites and permitting comparisons among sites in different cities, as well as establishing a basis for comparison of pollutant loading, e.g., mass per capita, etc.

An attempt was made to obtain the following data for the POTW treatment area and each individual sampling site:

## Table 3

### Description of Source Sites Used in Overall Data Analyis

| Sources | % Flow RES | COM | IND | Population | Flows (Lps) |
|---|---|---|---|---|---|
| **Residential** | | | | | |
| Kirkridge, C | 100 | 0 | 0 | 1,056 | 12.2 |
| Elco, C | - | - | - | 600 | 10.8 |
| Eppingham, S | 99 | 1 | 0 | 3,300 | 15.9 |
| Avocado, S | 94 | 6 | 0 | 6,929 | 31.9 |
| Brightwell, S | 96 | 4 | 0 | 1,545 | 7.8 |
| Northside, A | 73 | 27 | 0 | 10,280 | 104.0 |
| Warren, A | 100 | 0 | 0 | 2,416 | 9.0 |
| Franklin, H | 85 | 15 | 0 | 30,762 | 259.0 |
| Hillside, H | 97 | 3 | 0 | 2,312 | 31.1 |
| Tunxis, H. | 100 | 0 | 0 | 1,285 | 13.9 |
| Brentwood, H | 100 | 0 | 0 | 1,527 | 10.6 |
| **Commercial** | | | | | |
| DelFair, C | - | - | - | 2,731 | 20.4 |
| West Bourne, C | - | - | - | 3,201 | 19.4 |
| Cross Keys, S | 82 | 18 | 0 | 2,124 | 15.2 |
| Northwest, S | 55 | 45 | 0 | 3,160 | 37.2 |
| Lenox, A | 21 | 79 | 0 | 1,852 | 20.0 |
| DeKalb, A | 72 | 26 | 2 | 1,868 | 6.8 |
| Sixteenth, A | 18 | 42 | 41 | 12,810 | 234.0 |
| Clover, H | 2 | 98 | 0 | 14 | 7.1 |
| Potter, H | 66 | 29 | 5 | 70,931 | 603.0 |
| Seneca, H | 46 | 54 | 0 | 293 | 3.5 |
| **Industrial** | | | | | |
| Frost, S | 89 | 1 | 10 | 11,222 | 119.6 |
| Brown, S | 0 | 2 | 98 | 0 | 6.1 |
| Surrey, A | 3 | 4 | 93 | 500 | 42.0 |
| DeFoors, A | 11 | 12 | 77 | 1,951 | 82.0 |
| Ensign, A | 36 | 43 | 20 | 3,533 | 54.0 |

C = Cincinnati source

S = St. Louis source

A = Atlanta source

H = Hartford source

1) Population -- current or 1978
2) Number and ages of residences -- single, multiple, apartment
3) Land use -- residential, commercial, industrial, open, etc.
4) Characteristics of commercial areas -- number and types of firms including SIC categories where available, size, employment, etc.
5) Characteristics of industrial zones -- types of industrial firms, SIC categories, employment.

The goal in this program was to use published or publicly available data, extrapolating where necessary and confirming data sources through observation. In general, raw data were not collected.

### 1. Sources of Data

Sources of data which were common to most of the cities that were sampled included:

1) Census data, usually 1970, sometimes updated to 1975
2) Regional Planning Commissions
3) Municipal Planning Departments
4) Water or Sewer Departments
5) Industrial Councils, Chamber of Commerce, or local industry associations
6) Municipal housing, real estate, or zoning departments
7) 208 and 201 planning studies
8) Municipal industry directories

In most cases, the POTW's or sewer authority personnel either identified sources of demographic information or had collected this information for their own purposes.

### 2. Use of the Data

In general, census data were sufficient to provide both population and housing (residence) estimates. However, most of the census data were from 1970 and had to be updated to the current year, or 1978. The updating was generally accomplished through local population estimates made by planning commissions, municipal planning departments, or water and sewer departments. Quite often, these departments had made yearly population estimates or had an estimate in 1975 or 1978 which could be used as a basis for extrapolation to the present. In many cases, population estimates were made and updated. However, the number of residences were not updated. In these situations, estimates of number of persons per single family residence and per apartment were used to ascertain the number of residences and apartments from updated population statistics. In other cases, planning departments had updated numbers of residences available but not population data. In these cases estimates of number of persons per single family or apartment residences were again used to obtain population estimates.

One of the difficulties in using census data is that the boundaries of the POTW treatment area and the individual sampling sites do not often correspond to census blocks or census tracts. As a result, estimation was required in determining what fraction of the census block or tract was in each sampling area. Because of the larger size of the POTW treatment area, extrapolation of census data was usually easier since the POTW treatment area usually contained entire tracts and blocks. In the smaller sampling sites, use of census data became difficult. However, in most cases it was found that updated population data were available through the city regional planning commission. In some cases, sewer department personnel or municipal personnel provided estimates of increase in population or residences for selective sampling sites.

Census data as well as data available within each city were usually sufficient to determine the overall age of the sampling site. In general, an old residential site was considered to be one where the dwellings were constructed prior to World War II. A new residential site was defined as one whose dwellings were generally constructed after World War II. In some sampling sites, dwellings were still in the process of construction. This led to uncertainty in the number of houses and the population figures. In several cities, both population and residence data were obtained from several sources; these were compared and averaged to be used in analyzing the pollutant data.

It was generally more difficult to obtain a descriptive characterization of the commercial and industrial zones. This information usually came from municipal planning departments or regional commissions or water and sewer departments. In some cities, planning departments had available lists of all commercial and industrial establishments, their locations, their SIC categories, and employment data. Addresses and employment sometimes were considered confidential information and not provided. In other cases, city agencies accumulated data across several SIC categories before providing them to us. Characterization of the commercial and institutional aspects of sampling zones was usually more difficult than defining the industrial zones. Most water and sewer departments had listings of industrial accounts which could form a basis for a description of the industrial sector. In some cases, visual observations were required to determine the degree of commercialization or the types of establishments. For most shopping center type commercial zones t were sampled, it was possible to obtain from the shopping center developer or planner listings of the types of establishments.

In many cities, additional detailed data were available either from housing and tax assessment officers or from surveys which had been made using proprietary data, for example, R. L. Polk data. These data were generally not used since the level of detail provided in real estate or tax assessment documents was never actually needed, and the Polk priority data were expected to be more expensive than was appropriate in view of the limited amount of information desired.

If detailed characterizations of the commercial and industrial zones were required, much more primary data would have been required and would have added significantly to the cost of the program.

In general, the population data for both individual sampling sites and the POTW treatment area are estimated to be accurate to within ±5-10%. In general, the number of residences is estimated to be accurate to within ±10-15% since both sampling sites and cities vary somewhat in the number of individuals per dwelling.

## D. Sample Collection

Throughout the performance of this study, all sampling was accomplished by means of manual collection methods. Typically, a field crew of between 12 and 14 people was deployed in the basin of interest for a period of eight days to complete all aspects of the required sampling. The field crew was divided into two alternating shifts, each of which worked a minimum of 12 hours per day. Each shift was further divided into 3 teams of either 2 or 3 people. Two of these crews were directly involved in completing all collection portions of the field work at up to five remote locations. The third crew was responsible for logistical concerns (i.e., sorting, logging in, repackaging of all collected sample increments), as well as maintaining the working status (by providing essential supplies, repairing equipment, etc.) of the remote crews. To a limited extent, the logistics crew also participated in sampling activities by being responsible for the collection of influent, effluent and tap water samples.

Actual collection was completed using a two liter stainless steel graduate (bucket) and a telescopic pole (extended length of 9.75 meters). Normally, the first aliquot obtained was used to determine pH, temperature and to determine whether oxidizing species were present (by means of a potassium-iodide, starch indicating paper test). This volume was then discarded and additional aliquots were obtained to fill a predetermined number of sample bottles. Prior to leaving a site to move onto the next site, an instantaneous flow measurement was made and the results recorded. These flow measurements were used in the laboratory to flow composite all appropriate increments into the final sample for chemical analysis.

## E. Flow Measurement

Flow measurements were initially obtained using a depth of flow/Manning equation approach. In practice, the measured depth of water contained within a pipe can be used to determine the rate of water flow, if certain physical parameters of the pipe (pipe diameter, slope, and roughness coefficient) are also known. However, subsequent to the first basin studied, the accuracy of this approach, compared to those discussed below, was questioned because values obtained appeared to be unexplainably high. Similar observations were also obtained in the next two cities, but in these instances confirmation that the measured flows were too high was obtained by the results of theoretical flow balances.

The theoretical analysis was based on the assumption that the residential contribution to the basin flow was 100 gallons per day per person, and that all other activities (commercial, industrial, municipal, etc.) discharged as much as they consumed. By obtaining the water billing records of the area, it was possible to estimate a dry weather flow throughout a basin or for any individual site.

As a result of these theoretical analyses, additional flow measurement procedures were evaluated during the fourth city study. Included among the alternative procedures were a direct velocity determination/depth of flow approach, a Palmer-Bowles flume/Manning dipper approach and a Palmer-Bowles flume/depth of flow Manning equation approach.

The results of this study indicated that either of the first two approaches produced more reliable estimates of the actual flow rate than did the depth of flow/Manning equation technique. However, the flume/Manning dipper technique was somewhat more difficult to implement due to the additional effort required to install both the flumes and the dippers. Therefore, the velocity/depth of flow method was used to correct or recalibrate all depth of flow/Manning equation results that had been obtained from the first three city studies. The flow data used for the analyses in the report are all based on the velocity measured (or corrected) flow for each sampling site.

## F. Chemical Analysis

The analytical procedures used were those outlined in the EPA Screening Protocol for Priority Pollutants.[6] A few of the procedures were modified during the studies of each of the individual basins. These modifications are documented in the reports on the four individual drainage basins sampled.

A Quality Control (QC) program was developed for this study in order to establish the reliability of the data. The program was based upon the EPA recommendations.[7] Because the recovery and precision data were available from the QC program, it was possible to modify the analytical procedures where problems were indicated. Consequently, consistently low reporting levels were achieved throughout the study, independent of sample matrix interferences.

Included in Appendix A is a listing of reporting limits, recoveries and precision of measurement for each individual pollutant in the raw wastewater samples. Those data have been summarized by analysis category in Table 4. The data in this summary and in Appendix A demonstrate that the chemical concentration data for the samples have a high degree of reliability. It would not have been possible to achieve this degree of reliability or to document it without the QC program. For a few compounds the EPA screening protocol methods were problemmatic and these are indicated by footnote in Appendix A. There were only three priority pollutants for which it was not possible to obtain data, due to deficiencies in the analysis protocol. They were:

Bis(chloromethyl) ether
Hexachlorocyclopentadiene
2-Chloroethylvinyl ether

## Table 4

## Chemical Analysis Accuracy and Precision Summary

|  | METHOD REFERENCE STANDARD* |  | RAW WASTEWATER |  |
|---|---|---|---|---|
| Analysis Category | Average Recovery | Average Standard Deviation | Average Recovery | Average Standard Deviation |
| Volatiles | 92 | 18 | 88 | 23 |
| Acids | 79 | 16 | 86 | 16 |
| Base/Neutrals | 79 | 21 | 72 | 19 |
| Pesticides and PCB's | 77 | 14 | 75 | 15 |
| Total Cyanides | 96 | 8 | 91 | 12 |
| Total Phenols | 97 | 7 | 96 | 11 |
| Metals | 100 | 26 | 94 | 18 |
| Classical Parameters (7XX Series) | 81 | 14 | -- | -- |

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*Standards spiked into pure distilled water.

## IV. INTERPRETATION ANALYSIS OBJECTIVES

The entire POTW program has a large number of objectives ranging from an understanding of the sources, types and quantities of pollutants to knowledge of their treatment efficiency and the impact of plant design on that efficiency. This study has focused on those objectives which could be met by a study of the sources of pollutants. Table 5 lists briefly some of the objectives which were developed prior to the initiation of, and during the course of, this study.

The objectives have been grouped into three general categories to reflect the relative importance of each to the overall program goals. During this study it has been possible to directly address and supply information on each of the primary objectives. The characteristics of the source sites and schedule constraints allowed the examination of many, but not all, of the secondary objectives. The data reliability or QA/QC tertiary objective was addressed in detail for flow and concentration measurement and source descriptions. It will be necessary to conduct a study modified in several ways compared with the present study to address the remaining tertiary objectives. The next section (V) presents a detailed analysis of the data organized to address each of the objectives.

Table 5

Interpretation Analysis Objectives*

Primary

- Frequency of detection
- Presence or absence
- Quantity of pollutant (concentration and mass)
- Sources of pollutants
- Index values for each pollutant--to allow projections
- Mass Balances and examination of relative source concentrations

Secondary

- Examination of weekday/weekend differences
- Determination of site variance within source type
- Source variance between sources--are source types different
- City/City variance
- Correlations between chemicals or parameters
- Measurement and analysis (QA/QC) problems

Tertiary

- Steady state versus slug flow
- Separate/Combined sewers
- Type of housing
- Time of year
- Runoff
- Ultimate Source/SIC correlation for industrial sources

*For each of the toxic pollutants

# V. RESULTS AND DISCUSSION

The information from this study has been grouped into several categories for analysis, organized primarily by:

Frequency of detection
Concentration levels
Mass flows and balances
Examination of variances and correlations.

The frequency and concentration reviews are straight forward presentations of the basic data. In order to carry out the mass balance, indices of mass contribution have been calculated for each source category. These index values for each major category - residential, commercial, industrial - have been calculated from the sources for all four cities. These average values have been used both to compare with the actual POTW influent values for each of the cities studied and also to calculate some hypothetical mass flows for several different types of hypothetical cities varying in degree of flow from each source type.

The data from these studies are complex. The most accurate interpretations are carried out on a pollutant by pollutant basis. Some overall generalizations are possible, but with caution and with various exceptions.

The data have been grouped and reorganized in a variety of presentations in an effort to reveal the patterns implicit in the data.

## A. Frequency of Detection

The number of times any pollutant was detected in each source type--residential (RES), commercial (COM), industrial (IND), tap water and influent--was tabulated and is summarized in Table 6 for each category. That data, coverted to percentages are presented in Table 7. Those percentages are also shown graphically in Figures 6-10.

Table 8 summarizes the frequencies of occurrence for the two major categories -- organics and metals.

# Table 6

## Total Number of Observations

| | | Residential | Commercial | Industrial | Tap Water | Influent |
|---|---|---|---|---|---|---|
| Total Number of Samples | | 47 | 42 | 21 | 12 | 18 |
| 104. | Vinyl Chloride | | | 1 | | |
| 105. | Chloroethane | | | 1 | | |
| 108. | Trichlorofluoromethane | | | 1 | | 1 |
| 109. | Acrylonitrile | | | | | 1 |
| 110. | 1,1-Dichloroethylene | | 2 | 8 | | 3 |
| 111. | 1,1-Dichloroethane | | 1 | 7 | | 1 |
| 112. | Trans-1,2-dichloroethylene | | 18 | 8 | | 5 |
| 113. | Chloroform | 42[a] | 42 | 21 | 12 | 18 |
| 114. | 1,2-Dichloroethane | 1[a] | 2 | 3 | | 4 |
| 115. | 1,1,1-Trichloroethane | 14[a] | 22 | 15 | | 14 |
| 116. | Carbon tetrachloride | | 2 | 7 | | |
| 117. | Bromodichloromethane | 2[a] | 21 | 12 | 12 | 2 |
| 118. | 1,2-Dichloropropane | | | 1 | | |
| 119. | Trans-1,3-Dichloropropylene | | 1 | | | |
| 120. | Trichloroethylene | 5[a] | 6 | 21 | | 12 |
| 121. | Benzene | 10[a] | 21 | 16 | | 12 |
| 123. | Dibromochloromethane | 2[a] | 18 | 12 | 7 | 4 |
| 124. | 1,1,2-Trichloroethane | | | 1 | | |
| 125. | Bromoform | | | | 4 | |
| 126. | 1,1,2,2-Tetrachloroethane | 1[a] | | 2 | | 1 |
| 127. | 1,1,2,2-Tetrachloroethylene | 36[a] | 41 | 21 | 3 | 15 |
| 128. | Toluene | 29[a] | 38 | 21 | 1 | 14 |
| 129. | Chlorobenzene | 3[a] | 2 | 3 | | 1 |
| 130. | Ethylbenzene | 8[a] | 21 | 16 | 1 | 12 |
| 201. | 2-Chlorophenol | | | 2 | | |
| 203. | Phenol | 18 | 17 | 11 | | 6 |
| 204. | 2,4-Dimethylphenol | 3 | | 8 | | 2 |
| 205. | 2,4-Dichlorophenol | | | 2 | | |
| 206. | 2,4,6-Trichlorophenol | | | 2 | | |
| 207. | p-Chloro-m-cresol | | | | | 1 |
| 210. | Pentachlorophenol | 2 | 6 | 4 | | 4 |
| 301. | Dichlorobenzenes | 6 | 13 | 12 | | 10 |
| 310. | Nitrobenzene | 1 | | | | |
| 312. | 1,2,4-Trichlorobenzene | 1 | 1 | | | |
| 315. | Naphthalene | 4 | 7 | 13 | | 8 |
| 326. | Diethylphthalate | 23 | 15 | | 1 | 9 |
| 331. | Anthracene/Phenanthrene | 2 | 1 | 3 | | |
| 333. | Di-n-butylphthalate | 16 | 18 | 12 | 3 | 12 |
| 334. | Fluoranthene | 1 | | | | |
| 336. | Pyrene | 1 | | | | |
| 337. | Butylbenzylphthalate | 22 | 23 | 11 | | 8 |
| 338. | Bis (2-ethylhexyl)/di-n-octyl phthalate | 11 | 16 | 5 | 2 | 4 |
| 404. | Heptachlor | | 2 | | | 1 |
| 406. | Aldrin | 2 | | | | |
| 501. | Antimony | 16[a] | 3 | 6[d] | 2 | 7 |
| 502. | Arsenic | 16[a] | 16 | 9 | 3 | 8 |
| 504. | Cadmium | 7[a] | 5 | 8 | 1 | 10 |
| 505. | Chromium | 29[a] | 24[b] | 21 | 1 | 16 |
| 506. | Copper | 46[a] | 42 | 21 | 11 | 18 |
| 507. | Lead | 38[a] | 35 | 21 | 4 | 16 |
| 508. | Manganese | 45[a] | 42 | 21 | 6 | 18 |
| 509. | Mercury | 8[a] | 4 | 7 | | 3 |
| 510. | Nickel | 28[a] | 33 | 21 | 3 | 15 |
| 511. | Selenium | 26[a] | 16 | 3 | 4 | 5 |
| 512. | Silver | 10[a] | 20[c] | 18 | 1 | 17 |
| 513. | Thallium | | 4 | 1 | | |
| 514. | Zinc | 46[a] | 42 | 21 | 7 | 18 |
| 601. | Total Cyanides | 2 | 1 | 16 | | 11 |
| 602. | Total Phenols | 43 | 40 | 21 | 2 | 18 |

a. Out of 46 samples
b. Out of 41 samples
c. Out of 39 samples
d. Out of 12 samples

# Table 7

## Percentage Occurrence

| | | Residential | Commercial | Industrial | Tap Water | Influent |
|---|---|---|---|---|---|---|
| Total Number of Samples | | 47 | 42 | 21 | 12 | 18 |
| 104. | Vinyl Chloride | | | 5 | | |
| 106. | Chloroethane | | | 5 | | |
| 108. | Trichlorofluoromethane | | | 5 | | 6 |
| 109. | Acrylonitrile | | | | | 6 |
| 110. | 1,1-Dichloroethylene | | 5 | 38 | | 17 |
| 111. | 1,1-Dichloroethane | | 2 | 33 | | 6 |
| 112. | Trans-1,2-dichloroethylene | | 43 | 38 | | 28 |
| 113. | Chloroform | 91[a] | 100 | 100 | 100 | 100 |
| 114. | 1,2-Dichloroethane | 2[a] | 5 | 14 | | 11 |
| 115. | 1,1,1-Trichloroethane | 30[a] | 52 | 71 | | 78 |
| 116. | Carbon tetrachloride | | 5 | 33 | | |
| 117. | Bromodichloromethane | 4[a] | 50 | 57 | 100 | 11 |
| 118. | 1,2-Dichloropropane | | | 5 | | |
| 119. | Trans-1,3-Dichloropropylene | | 2 | | | |
| 120. | Trichloroethylene | 11[a] | 14 | 100 | | 67 |
| 121. | Benzene | 2[a] | 50 | 76 | | 67 |
| 123. | Dibromochloromethane | 4 | 43 | 57 | 58 | 22 |
| 124. | 1,1,2-Trichloroethane | | | 5 | | |
| 125. | Bromoform | | | | 33 | |
| 126. | 1,1,2,2-Tetrachloroethane | 2[a] | | 10 | | 6 |
| 127. | 1,1,2,2-Tetrachloroethylene | 78[a] | 98 | 100 | 25 | 83 |
| 128. | Toluene | 63[a] | 90 | 100 | 8 | 78 |
| 129. | Chlorobenzene | 7[a] | 5 | 14 | | 6 |
| 130. | Ethylbenzene | 17[a] | 50 | 76 | 8 | 67 |
| 201. | 2-Chlorophenol | | | 10 | | |
| 203. | Phenol | 38 | 40 | 52 | | 33 |
| 204. | 2,4-Dimethylphenol | 6 | | 38 | | 11 |
| 205. | 2,4-Dichlorophenol | | | 10 | | |
| 206. | 2,4,6-Trichlorophenol | | | 10 | | |
| 207. | p-Chloro-m-cresol | | | | | 6 |
| 210. | Pentachlorophenol | 4 | 14 | 19 | | 22 |
| 301. | Dichlorobenzenes | 13 | 31 | 57 | | 56 |
| 310. | Nitrobenzene | 2 | | | | |
| 312. | 1,2,4-Trichlorobenzene | 2 | 2 | | | |
| 315. | Naphthalene | 9 | 17 | 62 | | 44 |
| 328. | Diethylphthalate | 49 | 36 | | 8 | 50 |
| 331. | Anthracene/Phenanthrene | 4 | 2 | 14 | | |
| 333. | Di-n-butylphthalate | 34 | 43 | 57 | 25 | 67 |
| 334. | Fluoranthene | 2 | | | | |
| 335. | Pyrene | 2 | | | | |
| 337. | Butylbenzylphthalate | 47 | 55 | 52 | | 44 |
| 338. | Bis (2-ethylhexyl)/di-n-octyl phthalate | 23 | 38 | 24 | 17 | 22 |
| 404. | Heptachlor | | 5 | | | 6 |
| 408. | Aldrin | 4 | | | | |
| 601. | Antimony | 35[a] | 7 | 50[d] | 17 | 39 |
| 602. | Arsenic | 35[a] | 38 | 43 | 25 | 44 |
| 604. | Cadmium | 15[a] | 12 | 38 | 8 | 56 |
| 605. | Chromium | 63[a] | 59[b] | 100 | 8 | 89 |
| 606. | Copper | 100[a] | 100 | 100 | 92 | 100 |
| 607. | Lead | 82[a] | 83 | 100 | 33 | 89 |
| 608. | Manganese | 100[a] | 100 | 100 | 50 | 100 |
| 609. | Mercury | 17[a] | 10 | 33 | | 17 |
| 610. | Nickel | 61[a] | 79 | 100 | 25 | 83 |
| 611. | Selenium | 57[a] | 38 | 14 | 33 | 28 |
| 612. | Silver | 22[a] | 51[c] | 86 | 8 | 94 |
| 613. | Thallium | | 10 | 5 | | |
| 614. | Zinc | 100[a] | 100 | 100 | 58 | 100 |
| 701. | Total Cyanides | 4 | 2 | 76 | | 61 |
| 702. | Total Phenols | 93 | 95 | 100 | 17 | 100 |

a. Out of 46 samples
b. Out of 41 samples
c. Out of 39 samples
d. Out of 12 samples

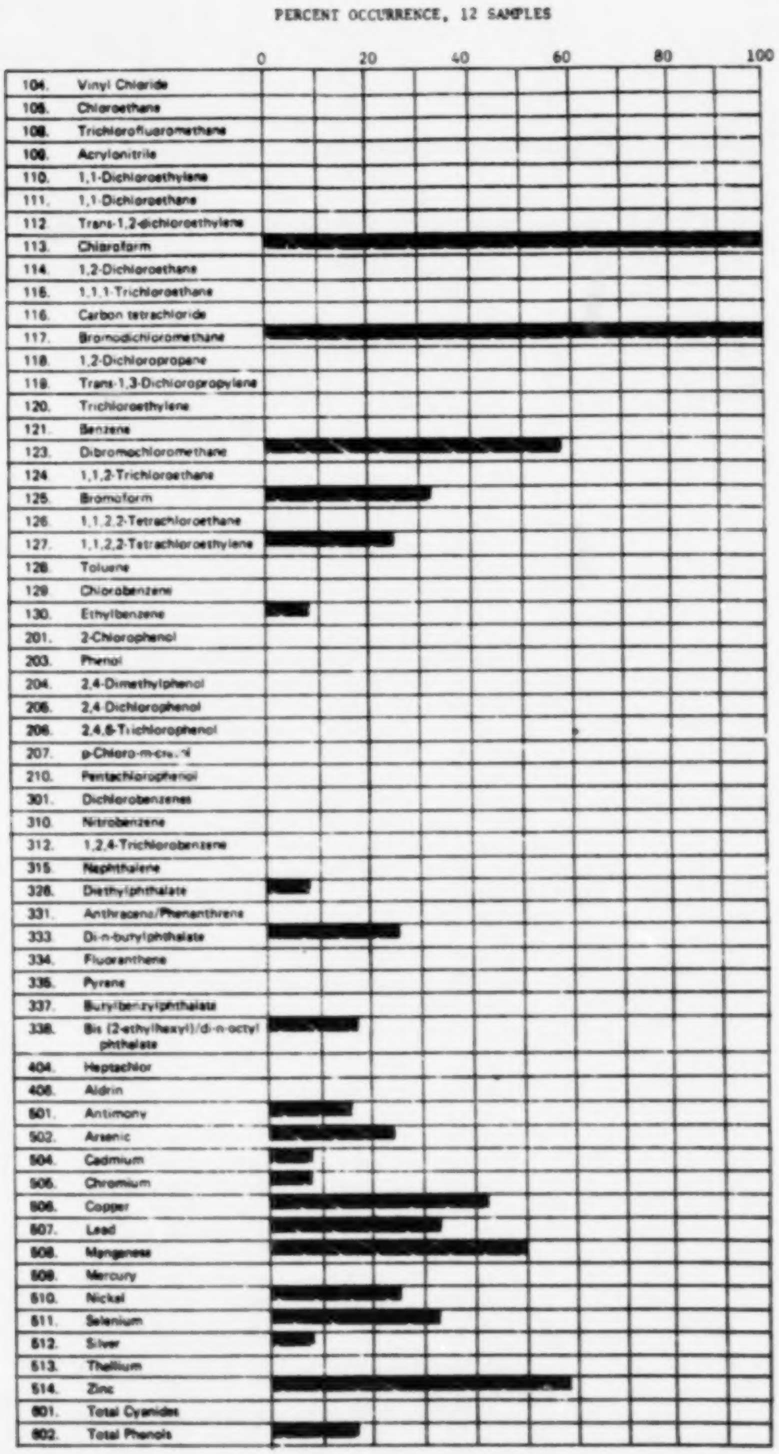

Figure 6: Frequency of Occurrence (%), Tap Water

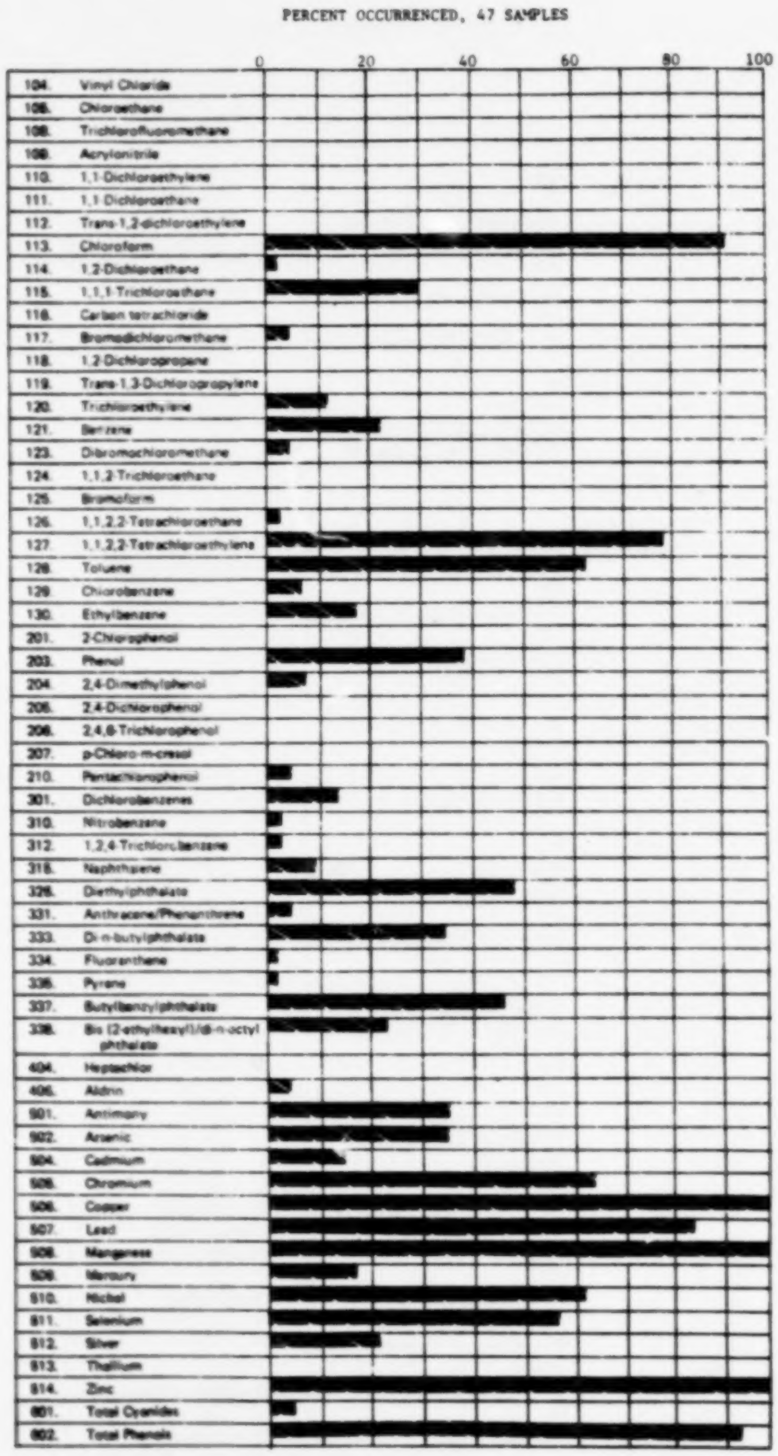

Figure 7: Frequency of Occurrence (%), Residential

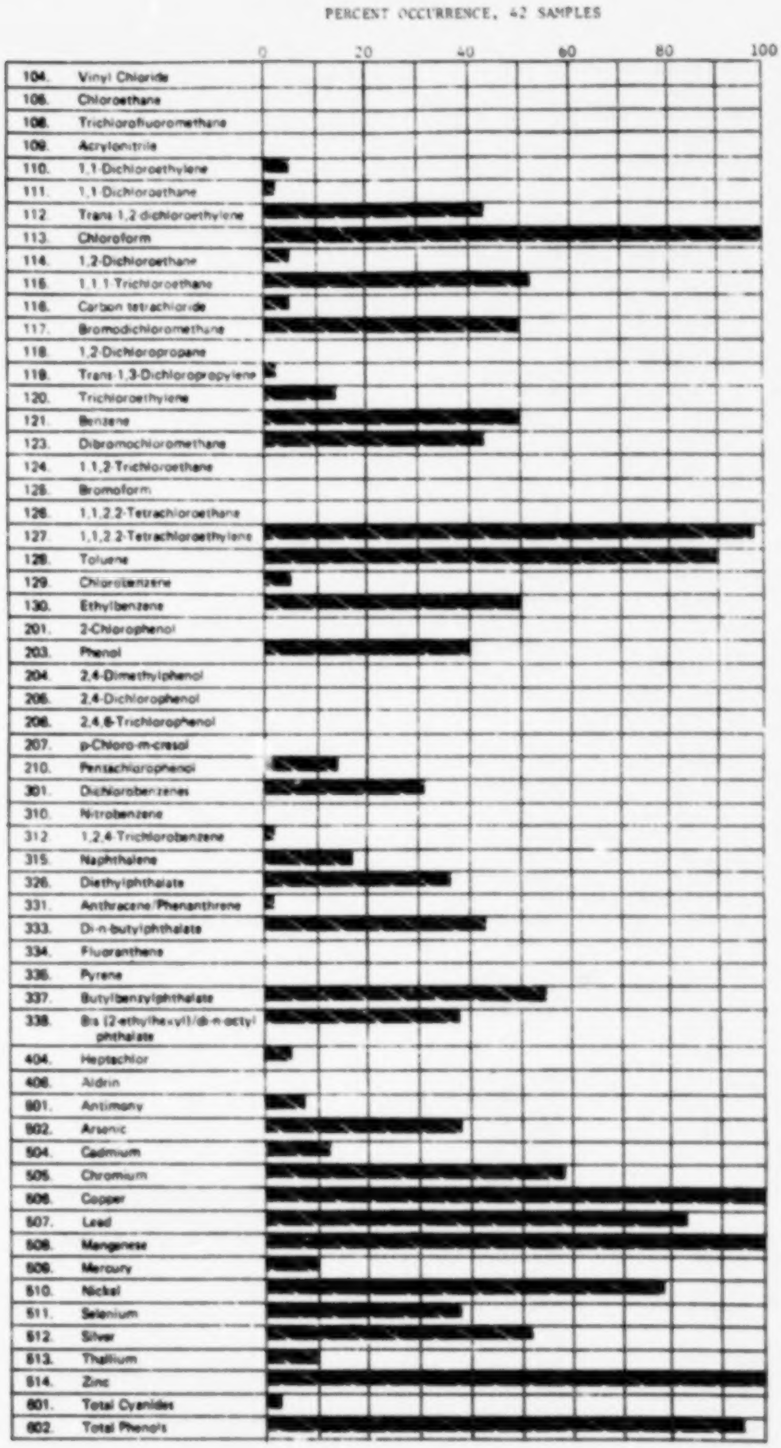

Figure 8: Frequency of Occurrence (%), Commercial

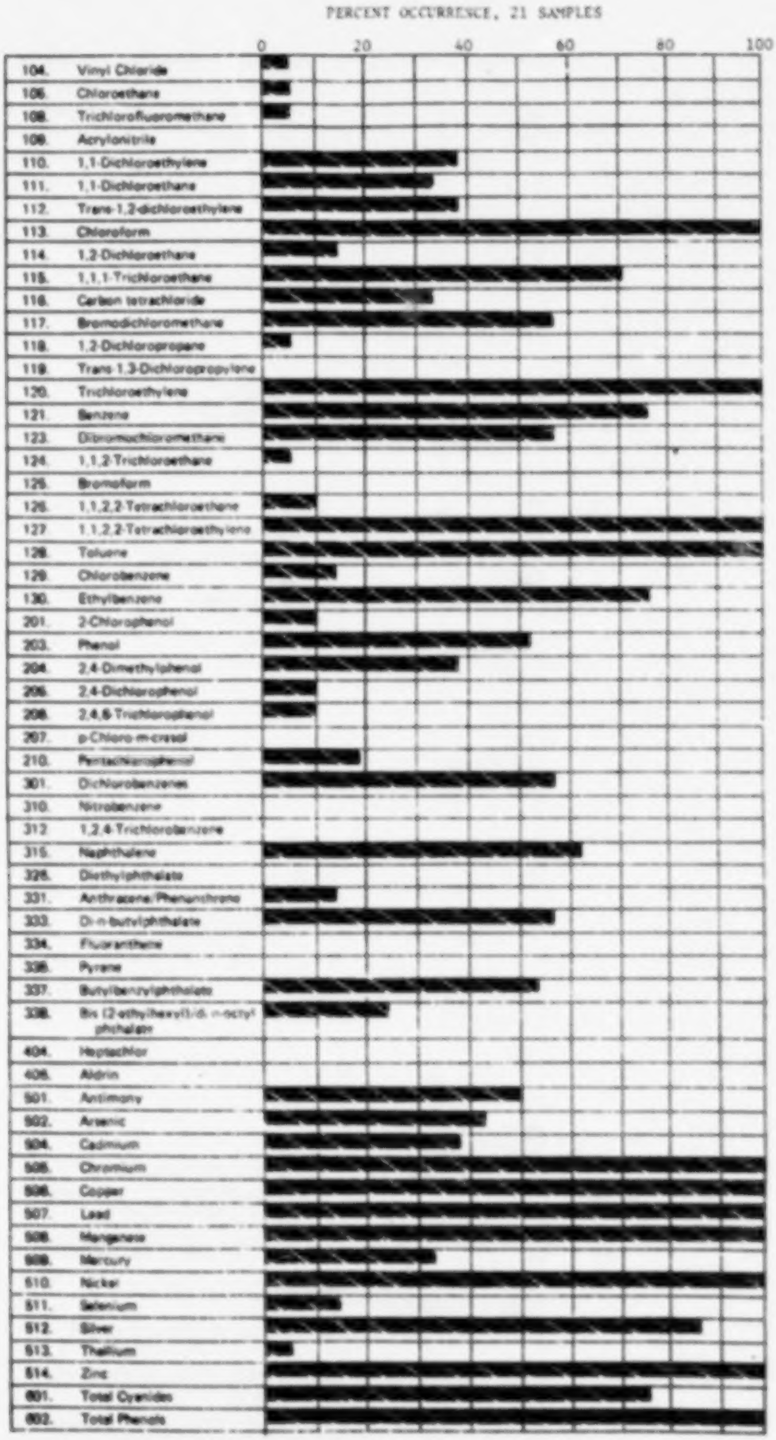

Figure 9: Frequency of Occurrence (%), Industrial

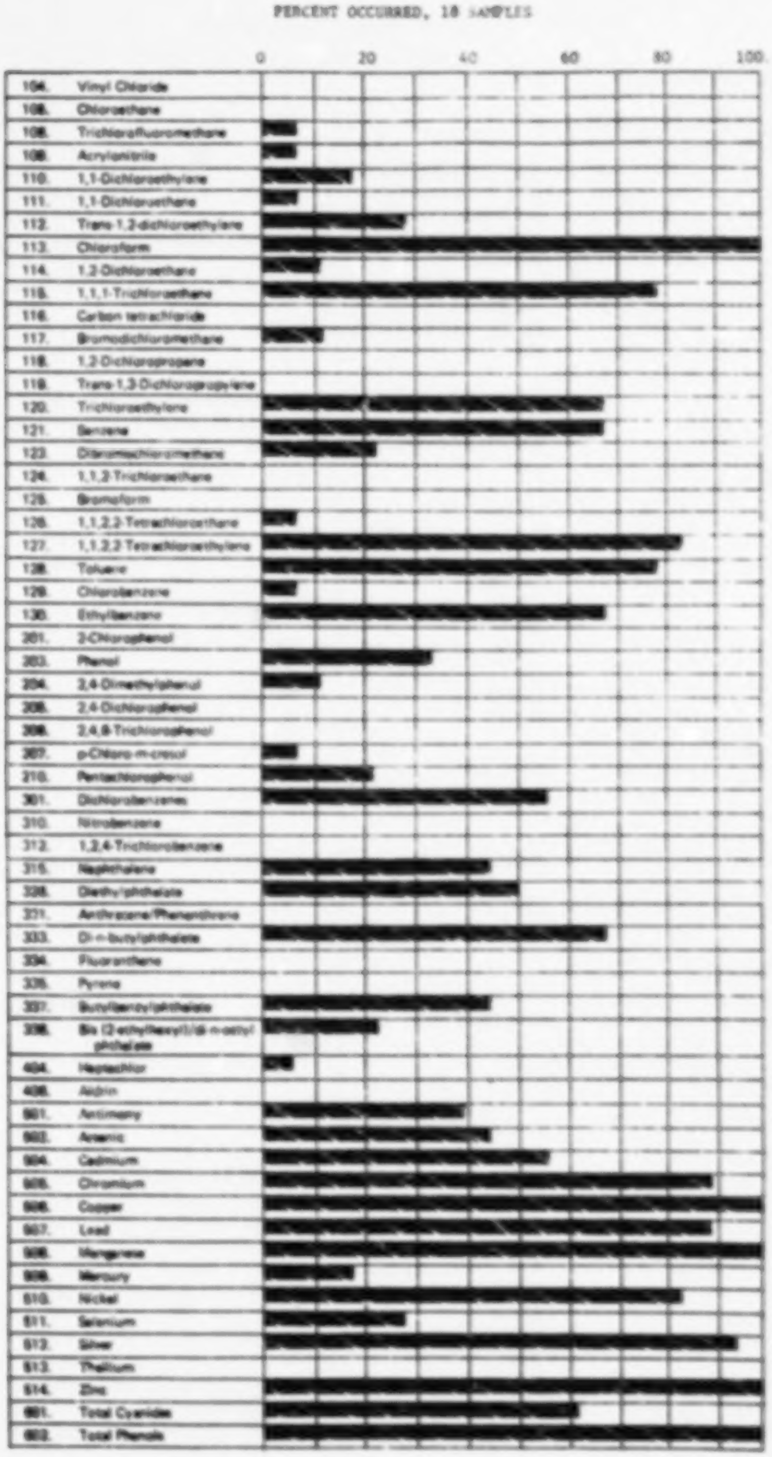

Figure 10: Frequency of Occurrence (%), POTW Influent

## Table 8

## Summary of Overall Frequency Observations

| | Organics (42)[1] | | | | Metals (13)[2] | | | |
|---|---|---|---|---|---|---|---|---|
| | Total[3] | ≥90% | ≥50% | <10% | Total[4] | ≥90% | ≥50% | ≤10% |
| Tap Water | 10 | 2[5] | 3 | 2 | 11 | 0 | 2 | 3 |
| Residential | 26 | 1 | 3 | 14 | 12 | 3 | 7 | 0 |
| Commercial | 27 | 3 | 8 | 9 | 13 | 3 | 7 | 1 |
| Industrial | 33 | 4 | 5 | 13 | 6 | 8 | 1 | 0 |
| Influent | 28 | 1 | 10 | 7 | 11 | 4 | 8 | 0 |

[1] 42 organic pollutants (volatiles, acids, base/neutrals).

[2] 13 metals (12 priority pollutants + manganese).

[3] Number of organic pollutants observed in each source category.

[4] Number of metals observed in each source category.

[5] Values are number of pollutants, out of the total in each analysis category, which were observed equal or greater than 90% of the time, equal or greater than 50% of the time or less than 10% of the time.

A total of 42 organic pollutants were observed at some time in one or another of the sources, but a maximum of 46 could be present --four of the organics are not resolved in the analysis scheme and are reported as groups.* The following list is a summary of the number of priority pollutants seen at some time in these sources.

| | |
|---|---|
| Volatiles | 24 |
| Acids | 7 |
| Base/Neutrals | 11 (could be 15*) |
| Pesticides | 2 |
| Metals | 12 plus manganese |
| Total Cyanides | |
| Total Phenols | |

The list of 67 priority pollutants given in Table 9 along with their reporting limits, were never detected in any of the samples in any city. In general the reporting limits refer to the concentration level which the analysis protocol was designed to measure reliably. Such is the case for instance for the pesticides at 1 μg/L and most of the other pollutants at 10 μg/L, and most of the other pollutants at 10 μg/L. Values higher than 10 μg/L represent detection limits.

Table 10 gives a list of pollutants (20) which were observed 0-3 times in at least one of the cities. Because the mass data for these chemicals was so sparse, they were excluded from the subsequent concentration and mass flow interpretations. The data for methylene chloride was excluded from these analyses because it is such a ubiquitous contaminant.

Table 11 gives a list of the 40 toxic pollutants which have been examined in detail in the subsequent sections of this report. The six classical parameters (7XX series) of ammonia, oil and grease, TSS, TOC, COD and BOD were also included in the detailed analysis. The data in Table 11 are given in terms of the number of times a pollutant was detected in a city. Only pollutants detected greater than three times in at least one city are included.

---

*The unresolved groups are:
Dichlorobenzenes - 3 isomers
Anthracene and Phenanthrene
Bis(2-ethylhexyl)phthalate and di-n-octyl phthalate

## Table 9

Sixty-Seven (67) Pollutants Never Derected in Four Cities

| Compound | Reporting Limit µg/L | Compound | Reporting Limit µg/L |
|---|---|---|---|
| 101 Chloromethane[a] | 5 | 340 Chrysene/Benzo(a)anthracene | 5-10 |
| 102 Dichlorodifluoromethane[a] | 5 | 342 3,3'-Dichlorobenzidine | 10 |
| 103 Bromomethane[a] | 5 | 343 Benzofluoranthenes | 1-5 |
| 107 Acrolein | 1-7 | 345 Benzo(a)pyrene | 5-10 |
| 122 Cis-1,3-dichloropropylene | 1 | 346 Indeno (1,2,3-c,d)pyrene | 5 |
| 202 Nitrophenol | 10-15 | 347 Dibenzo(a,h)Anthracene | 5-10 |
| 208 2,4-dinitrophenol[b] | 20-40 | 348 Benzo(g,h,i)perylene | 5-10 |
| 209 4,6-dinitro-2-cresol[b] | 20-40 | 349 TCDD | |
| 211 4-Nitrophenol[b] | 10-25 | 401 alpha-BHC | 1 |
| 304 Hexachloroethane | 10-20 | 402 gamma-BHC | 1 |
| 305 Bis(chloromethyl)ether[a] | | 403 beta-BHC | 1 |
| 306 Bis(2-chloroethyl)ether | 10-20 | 405 delta-BHC | 1 |
| 307 Bis(2-chloroisopropyl)ether | 10 | 407 Heptachlor epoxide | 1 |
| 308 N-Nitrosodimethylamine[b] | 10-70 | 408 Endosulfan I | 1 |
| 309 Nitrosodi-n-propylamine | 10-20 | 409 DDE | 1 |
| 311 Hexachlorobutadiene | 10 | 410 Dieldrin | 1 |
| 313 2-Chloroethyl vinyl ether[a] | | 411 Endrin | 1 |
| 314 Bis(2-chloroethoxy)methane | 10 | 412 DDD | 1 |
| 316 Isophorone | 10 | 413 Endosulfan II | 1 |
| 317 Hexachlorocyclopentadiene[a] | | 414 DDT | 1 |
| 318 2-Chloronaphthalene | 10 | 415 Endrin aldehyde | 1 |
| 319 Acenaphthylene | 10 | 416 Endosulfan sulfate | 1 |
| 320 Acenaphthene | 10 | 417 Chlordane | 1 |
| 321 Dimethyl phthalate | 10 | 418 Toxaphene | 1 |
| 322 2,6-Dinitrotoluene | 10 | 419 PCB-1221 | 1 |
| 323 4-Chlorophenyl phenyl ether | 10 | 420 PCB-1232 | 1 |
| 324 Fluorene | 10 | 421 PCB-1242 | 1 |
| 325 2,4-Dinitrotoluene | 10 | 422 PCB-1248 | 1 |
| 327 1,2-Diphenylhydrazine | 10 | 423 PCB-1254 | 1 |
| 328 N-Nitrosodiphenylamine | 10 | 424 PCB-1260 | 1 |
| 329 Hexachlorobenzene | 10 | 425 PCB-1016 | 1 |
| 330 4-Bromophenyl phenyl ether | 10 | 503 Beryllium | 1-3 |
| 336 Benzidine[b] | 10-20 | | |

[a] These compounds were not detected by the EPA method.
[b] Chromatographic problems encountered with these compounds.

Table 10

Priority Pollutants Never Observed Greater Than Three Times In Any One City*

| | | Number of Times Detected | | | |
|---|---|---|---|---|---|
| | | Cin. | St.L. | Atl. | Htfd. |
| 104. | Vinyl chloride | - | - | 1 | - |
| 105. | Chloroethane | - | - | 1 | - |
| 108. | Trichlorofluoromethane | - | - | 2 | - |
| 109. | Acrylonitrile | - | - | 1 | - |
| 118. | 1,2-Dichloropropane | - | 2 | 1 | - |
| 119. | Trans-1,3-dichloropropylene | - | 2 | - | - |
| 124. | 1,1,2-Trichloroethane | - | - | 1 | - |
| 126. | 1,1,2,2-Tetrachloroethane | 2 | - | 2 | - |
| 201. | 2-Chlorophenol | - | 1 | 1 | - |
| 205. | 2,4-Dichlorophenol | - | 1 | 1 | - |
| 206. | 2,4,6-Trichlorophenol | - | 1 | 1 | - |
| 207. | 4-Chloro-3-cresol | - | - | - | 1 |
| 310. | Nitrobenzene | - | - | - | 1 |
| 312. | 1,2,4-Trichlorobenzene | - | - | - | 2 |
| 331. | Anthracene/Phenanthrene | 1 | 1 | 3 | 1 |
| 334. | Fluoranthene | - | - | - | 1 |
| 335. | Pyrene | - | 1 | - | - |
| 404. | Heptachlor | 3 | - | - | - |
| 406. | Aldrin | - | 2 | - | - |

*Including influent, tap, and source samples. Dash means not detected.

## Table 11

## Pollutants Selected for Detailed Analysis - Frequency of Detection

**Compounds detected greater than 3 times in at least one city[a, b]**

| | | Number of Times Detected | | | |
|---|---|---|---|---|---|
| | | C(38) | S(56) | A(32) | H(28) |
| 110. | 1,1-Dichloroethylene | 1 | 3 | 10 | - |
| 111. | 1,1-Dichloroethane | - | 2 | 7 | - |
| 112. | Trans-1,2-dichloroethylene | - | 11 | 19 | 1 |
| 113. | Chloroform | 37 | 55 | 31 | 25 |
| 114. | 1,2-Dichloroethane | 2 | 1 | 4 | 1 |
| 115. | 1,1,1-Trichloroethane | 10 | 35 | 9 | 9 |
| 116. | Carbon tetrachloride | - | 2 | 7 | - |
| 117. | Bromodichloromethane | 16 | 34 | 2 | 4 |
| 120. | Trichloroethylene | - | 21 | 22 | 4 |
| 121. | Benzene | 16 | 41 | 10 | 1 |
| 123. | Dibromochloromethane | 13 | 37 | 1 | - |
| 125. | Bromoform | 4 | 1 | - | - |
| 127. | 1,1,2,2-tetrachloroethylene | 24 | 55 | 31 | 18 |
| 128. | Toluene | 21 | 54 | 27 | 11 |
| 129. | Chlorobenzene | 1 | 6 | 4 | - |
| 130. | Ethylbenzene | 16 | 24 | 19 | 3 |
| 203. | Phenol | 13 | 28 | 14 | 3 |
| 204. | 2,4-Dimethylphenol | 1 | 1 | 8 | - |
| 210. | Pentachlorophenol | 2 | - | 18 | - |
| 301. | Dichlorobenzenes | 2 | 34 | 7 | 5 |
| 315. | Naphthalene | 7 | 15 | 8 | 2 |
| 326. | Diethylphthalate | 27 | 21 | 1 | 3 |
| 333. | Di-n-butylphthalate | 25 | 29 | 8 | 7 |
| 337. | Butylbenzylphthalate | 11 | 43 | 11 | 6 |
| 338. | Bis(2-ethylhexyl)/di-n-octyl phthalate | 24 | 10 | 6 | 1 |
| 501. | Antimony | 4 | 26 | 5 | - |
| 502. | Arsenic | 36 | 5 | 4 | 11 |
| 504. | Cadmium | 11 | 15 | 7 | 2 |
| 505. | Chromium | 8 | 53 | 30 | 9 |
| 506. | Copper | 37 | 56 | 32 | 27 |
| 507. | Lead | 20 | 56 | 32 | 18 |
| 508. | Manganese | 36 | 54 | 32 | 25 |
| 509. | Mercury | 3 | 9 | 8 | 2 |
| 510. | Nickel | 13 | 55 | 32 | 11 |
| 511. | Selenium | 22 | 38 | 3 | 3 |
| 512. | Silver | 20 | 25 | 3 | 5 |
| 513. | Thallium | 4 | 2 | - | - |
| 514. | Zinc | 35 | 55 | 32 | 26 |
| 601. | Total Cyanides | 4 | 20 | 12 | 1 |
| 602. | Total Phenols | 35 | 57 | 30 | 20 |

**[a] C = Cincinnati: 38 24-hr composite samples**
**S = St. Louis: 56 24-hr composite samples**
**A = Atlanta: 32 48-hr composite samples**
**H = Hartford: 28 48-hr composite samples**

**Sources, influent and tap water samples included; field blanks not included.**

**[b] Methylene Chloride (106) was observed as a contaminant in almost all of the samples.**

## B. Observed Pollutant Concentration Levels

### 1. Concentrations

The original concentration data for the 24 or 48 hour composite samples were averaged on a flow-weighted basis to produce a single number for the six-day sampling period at each site. These concentration values are summarized in Tables 12-16 along with the grand average value and, where appropriate the standard deviation, for the tap water, residential, commercial, industrial, and POTW influent samples. The per capita (mg/person/day) discharge for residential sources is given in Table 17.

For many of the pollutants in the residential and commercial categories, the standard deviation is about the same value as the average. Although an average industrial concentration value has been calculated for the purposes of testing mass balances, there may not be real significance to the concept of an average industrial value.

For the purposes of developing a projection model, each source type was considered to be part of the same overall population. Average concentration data were calculated for each category by averaging similar source sites within a city and then averaging between the cities. For the residential per capita values, the per capita rate was calculated for each site and then averaged on a population weighted basis, within the city, followed by a straight average of the cities.

The average concentration values for each of the source categories are shown in Table 18. From this table, it is clear that the industrial sources are the most intense for most of the chemicals, but the residential sources are important contributors of some pollutants such as diethyl phthalate and copper. Some of the pollutants which show residences as the most intense source (antimony, arsenic) are present at very low levels. A number of pollutants show equivalent intensity levels across source types, such as chloroform, manganese, and the classical parameters. The source comparisons are best done on a mass basis, as are presented in Part C of this section.

## Table 12

### Tap Water Concentration Summary (μg/L)*

| POLLUTANT | Cincinnati | St. Louis | Atlanta | Hartford | Average | Standard** Deviation |
|---|---|---|---|---|---|---|
| 110 1,1-DICHLOROETHYLENE | .0 | .0 | .0 | .0 | .0 | .0 |
| 111 1,1-DICHLOROETHANE | .0 | .0 | .0 | .0 | .0 | .0 |
| 112 TRANS-1,2-DICHLOROETHYLENE | .0 | .0 | .0 | .0 | .0 | .0 |
| 113 CHLOROFORM | 39.5 | 21.0 | 21.5 | 26.3 | 27.1 | 8.6 |
| 114 1,2-DICHLOROETHANE | .0 | .0 | .0 | .0 | .0 | .0 |
| 115 1,1,1-TRICHLOROETHANE | .0 | .0 | .0 | 2.5 | .6 | 1.3 |
| 116 CARBON TETRACHLORIDE | .0 | .0 | .0 | .0 | .0 | .0 |
| 117 BROMODICHLOROMETHANE | 16.8 | 12.5 | 3.5 | 2.5 | 8.8 | 6.9 |
| 120 TRICHLOROETHYLENE | .0 | .0 | .0 | .0 | .0 | .0 |
| 121 BENZENE | .0 | .0 | .0 | .0 | .0 | .0 |
| 123 DIBROMOCHLOROMETHANE | 15.0 | 8.0 | .5 | .0 | 5.9 | 7.1 |
| 125 BROMOFORM | 1.8 | 1.5 | .0 | .0 | .8 | .9 |
| 127 1,1,2,2-TETRACHLOROETHYLENE | .0 | 1.5 | 1.5 | .0 | .8 | .9 |
| 128 TOLUENE | .0 | 1.0 | .0 | .0 | .3 | .5 |
| 129 CHLOROBENZENE | .0 | .0 | .0 | .0 | .0 | .0 |
| 130 ETHYL BENZENE | .3 | .0 | .0 | .0 | .1 | .1 |
| 203 PHENOL | .0 | .0 | .0 | .0 | .0 | .0 |
| 204 2,4-DIMETHYLPHENOL | .0 | .0 | .0 | .0 | .0 | .0 |
| 210 PENTACHLOROPHENOL | .0 | .0 | .0 | .0 | .0 | .0 |
| 301 DICHLOROBENZENES | .0 | .0 | .0 | .0 | .0 | .0 |
| 315 NAPHTHALENE | .0 | .0 | .0 | .0 | .0 | .0 |
| 326 DIETHYL PHTHALATE | 3.3 | .0 | .0 | .0 | .8 | 1.6 |
| 333 DI-N-BUTYL PHTHALATE | 14.3 | .0 | .0 | 3.8 | 4.5 | 6.7 |
| 337 BUTYL BENZYL PHTHALATE | .0 | .0 | .0 | .0 | .0 | .0 |
| 338 BIS(2-ETHYLHEXYL)PHTHALATE | 16.5 | .0 | .0 | .0 | 4.1 | 8.3 |
| 501 ANTIMONY | .0 | 12.0 | .0 | .0 | 3.0 | 6.0 |
| 502 ARSENIC | 6.3 | .0 | .0 | .0 | 1.6 | 3.1 |
| 504 CADMIUM | 2.0 | .0 | .0 | .0 | .5 | 1.0 |
| 505 CHROMIUM | 10.0 | .0 | .0 | .0 | 2.5 | 5.0 |
| 506 COPPER | 28.0 | 6.5 | 22.5 | 56.6 | 28.4 | 21.0 |
| 507 LEAD | .0 | 28.5 | 13.0 | .0 | 10.4 | 13.5 |
| 508 MANGANESE | 7.5 | .0 | 6.5 | 6.3 | 5.1 | 3.4 |
| 509 MERCURY | .0 | .0 | .0 | .0 | .0 | .0 |
| 510 NICKEL | 13.0 | .0 | 4.0 | .0 | 4.3 | 6.1 |
| 511 SELENIUM | 3.5 | 8.0 | .0 | .0 | 2.9 | 3.8 |
| 512 SILVER | 1.0 | .0 | .0 | .0 | .3 | .5 |
| 513 THALLIUM | .0 | .0 | .0 | .0 | .0 | .0 |
| 514 ZINC | 27.5 | 14.5 | 210.0 | 15.8 | 66.9 | 95.6 |
| 601 TOTAL CYANIDES | .0 | .0 | .0 | .0 | .0 | .0 |
| 602 TOTAL PHENOLS | 8.0 | .0 | .0 | .0 | 2.0 | 4.0 |
| 703 AMMONIA | .1 | .4 | .0 | .3 | .2 | .2 |
| 704 OIL AND GREASE | .0 | .0 | .0 | .0 | .0 | .0 |
| 705 TSS | 1.3 | .0 | .0 | .0 | .3 | .6 |
| 706 TOC | 4.3 | 8.0 | 4.5 | .3 | 4.3 | 3.2 |
| 707 COD | .0 | .0 | .0 | .0 | .0 | .0 |
| 708 BOD | .0 | .0 | .0 | .0 | .0 | .0 |

* Classicals in mg/L.

**Standard Deviation = $\frac{\Sigma \bar{X}-X}{n-1}$

## Table 13

## Residential Concentration Summary (μg/L)*

| | Cinn. | | St. Louis | | | Atlanta | | Hartford | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| POLLUTANT | Kirkridge | Elco | Eppingham | Avocado | Brightwell | Northside | Warren | Franklin | Hillside | Tunxis | Brentwood | Average | Standard Deviation |
| 110 1,1-DICHLOROETHYLENE | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 |
| 111 1,1-DICHLOROETHANE | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 |
| 112 TRANS-1,2-DICHLOROETHYLENE | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 |
| 113 CHLOROFORM | 1.5 | 2.6 | 2.9 | 3.4 | 8.3 | 3.7 | 4.7 | 3.3 | 4.6 | .0 | 2.7 | 3.0 | .9 |
| 114 1,2-DICHLOROETHANE | .0 | .0 | .0 | .0 | .7 | .0 | .0 | .0 | .0 | .0 | .0 | .1 | .1 |
| 115 1,1,1-TRICHLOROETHANE | .0 | .2 | 4.6 | .6 | 1.2 | 1.3 | .0 | .0 | .9 | .0 | 24.2 | 2.3 | 2.8 |
| 116 CARBON TETRACHLORIDE | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 |
| 117 BROMODICHLOROMETHANE | .0 | .1 | .0 | .0 | .3 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .1 |
| 120 TRICHLOROETHYLENE | .0 | .0 | .0 | 1.6 | .3 | 2.1 | .0 | .0 | .0 | .0 | .0 | .4 | .5 |
| 121 BENZENE | .0 | .3 | .7 | .2 | 1.5 | .0 | .0 | .0 | .0 | .0 | .0 | .2 | .4 |
| 123 DIBROMOCHLOROMETHANE | .0 | .1 | .0 | .0 | .3 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 |
| 125 BROMOFORM | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 |
| 127 1,1,2,2-TETRACHLOROETHYLENE | .4 | 1.7 | 21.3 | 15.0 | 15.9 | 8.6 | 2.0 | 3.9 | 1.6 | .3 | .7 | 6.3 | 7.6 |
| 128 TOLUENE | .5 | 4.5 | 2.1 | 5.4 | 11.9 | 1.3 | .5 | 1.9 | .0 | .0 | .0 | 2.6 | 2.7 |
| 129 CHLOROBENZENE | .0 | .2 | .0 | .0 | .3 | .0 | .0 | .0 | .0 | .0 | .0 | .1 | .1 |
| 130 ETHYL BENZENE | .2 | .8 | .0 | .0 | 3.4 | .0 | .3 | .0 | .0 | .0 | .0 | .4 | .6 |
| 203 PHENOL | 1.5 | 23.6 | 2.1 | 15.4 | 6.2 | .0 | 5.1 | .0 | .0 | .0 | .0 | 5.8 | 6.6 |
| 204 2,4-DIMETHYLPHENOL | .0 | .7 | .0 | 2.1 | .0 | .0 | 3.7 | .0 | .0 | .0 | .0 | .7 | .8 |
| 210 PENTACHLOROPHENOL | .0 | .0 | .0 | .0 | .0 | 9.7 | .0 | .0 | .0 | .0 | .0 | 1.2 | 2.4 |
| 301 DICHLOROBENZENES | .0 | .0 | .0 | 12.8 | 20.3 | .0 | .0 | .0 | .0 | .0 | .0 | 2.8 | 5.5 |
| 315 NAPHTHALENE | .0 | 1.2 | .0 | .0 | 19.2 | .0 | .0 | 5.3 | .0 | .0 | .0 | 2.1 | 2.9 |
| 326 DIETHYL PHTHALATE | 16.8 | 35.6 | 13.3 | 11.3 | 3.4 | .0 | .0 | .0 | .0 | .0 | 15.0 | 9.8 | 11.6 |
| 333 DI-N-BUTYL PHTHALATE | 18.6 | 13.1 | 8.5 | 23.8 | 7.1 | .0 | 5.0 | .0 | .0 | 14.5 | 3.2 | 9.0 | 6.5 |
| 337 BUTYL BENZYL PHTHALATE | 7.5 | 9.8 | 13.2 | 11.9 | 24.7 | .0 | .0 | .0 | .0 | .0 | 8.3 | 6.8 | 7.5 |
| 338 BIS(2-ETHYLHEXYL)PHTHALATE | 7.4 | 13.9 | 2.9 | .0 | 46.3 | .0 | .0 | .0 | .0 | .0 | .0 | 6.8 | 8.1 |
| 501 ANTIMONY | .0 | 3.2 | 12.6 | 12.4 | .0 | .0 | 1.9 | .0 | .0 | .0 | .0 | 2.7 | 3.8 |
| 502 ARSENIC | 19.6 | 15.9 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | 2.5 | 3.4 | 4.8 | 8.7 |
| 504 CADMIUM | .0 | .5 | 1.4 | 1.0 | 6.2 | .0 | 1.6 | .0 | .0 | .0 | 13.9 | 1.8 | 1.6 |
| 505 CHROMIUM | 8.5 | 23.2 | 10.5 | 7.6 | 10.3 | 24.2 | 7.0 | 84.0 | 13.3 | .0 | .0 | 16.3 | 6.1 |
| 506 COPPER | 139.6 | 95.5 | 30.9 | 35.5 | 139.3 | 38.6 | 44.2 | 74.8 | 41.1 | 61.0 | 67.0 | 72.1 | 32.4 |
| 507 LEAD | .0 | 48.0 | 55.3 | 54.6 | 792.1 | 41.7 | 41.5 | 44.8 | 5.2 | 13.2 | 29.2 | 57.3 | 135.8 |
| 508 MANGANESE | 84.6 | 131.2 | 199.0 | 219.6 | 107.3 | 180.5 | 245.9 | 78.9 | 199.1 | 64.0 | 120.0 | 153.0 | 50.2 |
| 509 MERCURY | .0 | .3 | .5 | 2.1 | .9 | .0 | .0 | .0 | .0 | .0 | .7 | .4 | .6 |
| 510 NICKEL | .0 | 4.0 | 9.8 | 8.1 | 10.1 | 3.0 | 5.6 | 2.8 | .0 | .0 | 1.7 | 4.2 | 3.7 |
| 511 SELENIUM | 3.9 | 5.3 | 7.8 | 13.7 | 8.8 | .0 | .0 | .0 | .7 | .6 | .0 | 3.8 | 4.7 |
| 512 SILVER | .7 | .2 | 4.6 | 11.4 | .7 | 5.5 | .0 | .0 | .0 | .0 | .0 | 2.2 | 2.5 |
| 513 THALLIUM | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 |
| 514 ZINC | 130.7 | 134.2 | 102.8 | 97.2 | 1215.3 | 133.6 | 207.2 | 100.2 | 49.6 | 54.3 | 121.0 | 214.0 | 175.7 |
| 601 TOTAL CYANIDES | .0 | .0 | .0 | .0 | 2.0 | 7.5 | .0 | .0 | .0 | .0 | .0 | 1.1 | 1.8 |
| 602 TOTAL PHENOLS | 29.8 | 56.1 | 35.7 | 40.9 | 37.1 | 20.4 | 20.7 | 40.9 | 22.1 | .0 | 24.9 | 30.8 | 11.3 |
| 703 AMMONIA | 24.4 | 21.7 | 16.2 | 21.2 | 16.6 | 9.1 | 9.0 | 4.7 | 2.5 | 7.7 | 12.4 | 14.2 | 7.6 |
| 704 OIL AND GREASE | 53.7 | 69.0 | 41.5 | 54.1 | 489.8 | 29.3 | 33.9 | 33.8 | 15.2 | 19.8 | 17.1 | 77.4 | 80.3 |
| 705 TSS | 151.1 | 330.6 | 101.8 | 133.8 | 147.7 | 77.0 | 294.0 | 44.9 | 18.3 | 38.5 | 190.5 | 156.4 | 72.5 |
| 706 TOC | 90.3 | 110.4 | 90.0 | 124.6 | 110.0 | 59.1 | 74.2 | 46.2 | 29.7 | 62.1 | 64.8 | 81.5 | 27.3 |
| 707 COD | 277.0 | 356.4 | 194.5 | 292.5 | 310.2 | 361.8 | 182.3 | 170.3 | 112.4 | 221.0 | 299.7 | 263.8 | 47.7 |
| 708 BOD | 117.9 | 176.0 | 115.9 | 183.6 | 159.9 | 75.4 | 90.2 | 60.0 | 16.3 | 75.1 | 138.0 | 113.3 | 42.1 |

*Classicals in mg/L

Table 14

Commercial Concentration Summary (μg/L)*

| POLLUTANT | Cinn. | | St. Louis | | Atlanta | | | Hartford | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Delfair | West Bourne | Cross Keys | Northwest | Lenox | DeKalb | Sixteenth | Clover | Parker | Seneca | Average | Standard Deviation |
| 110 1,1-DICHLOROETHYLENE | .0 | .1 | 1.3 | .8 | .0 | .0 | .0 | .0 | .0 | .0 | .3 | .5 |
| 111 1,1-DICHLOROETHANE | .0 | .1 | .0 | .5 | .0 | .0 | .0 | .0 | .0 | .0 | .1 | .1 |
| 112 TRANS-1,2-DICHLOROETHYLENE | .4 | .0 | 2.7 | .0 | 2.0 | 9.2 | 2.2 | .0 | .0 | .7 | 1.5 | 2.0 |
| 113 CHLOROFORM | 6.0 | 4.2 | 6.3 | 5.8 | 6.6 | 16.2 | 6.4 | 9.0 | 4.3 | 5.1 | 6.7 | 2.0 |
| 114 1,2-DICHLOROETHANE | .0 | .4 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | 1.0 | .1 | .2 |
| 115 1,1,1-TRICHLOROETHANE | 1.7 | 3.2 | .8 | 10.3 | 2.4 | 1.7 | .0 | .0 | 7.1 | .0 | 2.9 | 1.8 |
| 116 CARBON TETRACHLORIDE | .0 | .0 | .0 | .0 | .0 | .0 | 1.1 | .0 | .0 | .0 | .1 | .2 |
| 117 BROMODICHLOROMETHANE | 2.3 | 1.1 | 2.5 | 2.0 | .0 | .0 | .0 | .0 | .0 | .0 | 1.0 | 1.2 |
| 120 TRICHLOROETHYLENE | .0 | .0 | .0 | .0 | .0 | 73.0 | 80.9 | .0 | .3 | .0 | 12.8 | 25.6 |
| 121 BENZENE | .4 | 10.3 | 1.0 | 4.6 | .0 | .0 | 1.3 | .0 | .0 | 6.2 | 2.7 | 2.1 |
| 123 DIBROMOCHLOROMETHANE | 1.6 | .7 | 2.0 | 1.5 | .0 | .0 | .0 | .0 | .0 | .0 | .7 | .9 |
| 125 BROMOFORM | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 |
| 127 1,1,2,2-TETRACHLOROETHYLENE | 6.7 | 3.0 | 45.2 | 20.9 | 9.5 | 81.6 | 2.6 | 6.3 | 25.0 | 18.0 | 21.4 | 13.3 |
| 128 TOLUENE | 7.4 | 27.6 | 6.0 | 24.4 | 2.1 | 4.3 | 1.1 | 6.0 | 7.5 | 12.4 | 11.0 | 6.8 |
| 129 CHLOROBENZENE | .0 | .0 | .0 | .3 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .1 |
| 130 ETHYL BENZENE | 3.6 | 11.5 | .2 | 3.6 | 5.9 | .0 | .0 | .7 | .6 | 1.0 | 3.0 | 3.1 |
| 203 PHENOL | 5.2 | 4.7 | 6.1 | 4.3 | 3.5 | 6.6 | .0 | 13.7 | .0 | .0 | 4.5 | .8 |
| 204 2,4-DIMETHYLPHENOL | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 |
| 210 PENTACHLOROPHENOL | .0 | .0 | .0 | .0 | 41.5 | .0 | 27.8 | .0 | .0 | .0 | 5.8 | 11.5 |
| 301 DICHLOROBENZENES | 2.4 | .0 | 25.9 | 22.9 | .0 | 7.0 | .0 | .0 | 6.6 | .0 | 7.5 | 11.3 |
| 315 NAPHTHALENE | 1.6 | 13.0 | .0 | 4.5 | .0 | .0 | .0 | .0 | 3.1 | .0 | 2.6 | 3.2 |
| 326 DIETHYL PHTHALATE | 13.0 | 15.6 | 12.1 | 5.3 | .0 | .0 | .0 | .0 | .0 | .0 | 5.7 | 7.0 |
| 333 DI-N-BUTYL PHTHALATE | 38.2 | 17.6 | 4.8 | 15.7 | 4.6 | .0 | 4.5 | 17.3 | .0 | .0 | 11.7 | 11.2 |
| 337 BUTYL BENZYL PHTHALATE | 13.6 | 5.7 | 16.3 | 13.5 | .0 | 33.0 | .0 | 12.3 | 4.6 | 3.6 | 10.6 | 3.3 |
| 338 BIS(2-ETHYLHEXYL)PHTHALATE | 22.3 | 14.3 | 4.5 | 4.1 | .0 | 20.5 | .0 | .0 | 4.3 | .0 | 7.7 | 7.4 |
| 501 ANTIMONY | 1.7 | .0 | .0 | .0 | .5 | .0 | .6 | .0 | .0 | .0 | .3 | .4 |
| 502 ARSENIC | 9.6 | 7.9 | .0 | .0 | .0 | .0 | .0 | .0 | 1.2 | 3.7 | 2.6 | 4.2 |
| 504 CADMIUM | 2.0 | 1.8 | .0 | .0 | .0 | .0 | .0 | .0 | 1.2 | .0 | .6 | .9 |
| 505 CHROMIUM | .0 | .0 | 6.8 | 20.8 | 423.8 | 6.6 | 113.1 | .0 | 83.5 | 13.1 | 56.8 | 84.0 |
| 506 COPPER | 35.3 | 57.0 | 41.7 | 32.2 | 51.3 | 52.2 | 45.2 | 95.1 | 93.3 | 67.3 | 54.5 | 21.2 |
| 507 LEAD | .9 | 31.4 | 87.1 | 88.3 | 49.3 | 38.7 | 108.6 | 24.7 | 58.7 | 5.6 | 49.8 | 32.8 |
| 508 MANGANESE | 449.3 | 318.0 | 91.5 | 269.2 | 178.2 | 154.9 | 183.7 | 25.0 | 130.1 | 333.3 | 224.8 | 106.2 |
| 509 MERCURY | .0 | .2 | .7 | .5 | .0 | .0 | .0 | .0 | .0 | 2.7 | .4 | .4 |
| 510 NICKEL | 12.1 | 18.2 | 7.8 | 7.5 | 5.5 | 18.3 | 6.7 | 6.3 | 36.7 | 5.2 | 12.4 | 3.9 |
| 511 SELENIUM | 4.2 | 1.3 | 18.1 | .7 | 1.8 | .0 | 1.0 | .0 | .0 | .6 | 3.3 | 4.2 |
| 512 SILVER | 1.4 | 1.0 | 1.1 | [illegible] | 9.1 | .0 | 12.6 | .0 | 1.0 | 3.5 | 2.5 | 3.0 |
| 513 THALLIUM | .4 | .5 | .9 | .3 | .0 | .0 | .0 | .0 | .0 | .0 | .1 | .2 |
| 514 ZINC | 142.5 | 133.7 | 119.9 | 75.5 | 171.9 | 134.5 | [illegible] | 219.2 | 182.0 | 76.5 | 138.1 | 50.3 |
| 601 TOTAL CYANIDES | .0 | .0 | .0 | 1.7 | .0 | .0 | .0 | .0 | .0 | .0 | .2 | .6 |
| 602 TOTAL PHENOLS | 38.0 | 35.7 | 32.0 | 30.7 | 43.5 | 40.5 | 36.0 | 38.5 | 17.3 | 62.5 | 37.0 | 4.0 |
| 703 AMMONIA | 14.2 | 24.8 | 8.7 | 9.9 | 22.6 | 5.6 | 4.3 | 7.5 | 7.6 | 9.2 | 10.7 | [illegible] |
| 704 OIL AND GREASE | 300.7 | 121.5 | 48.7 | 41.4 | 123.8 | 69.6 | 62.0 | 125.2 | 139.5 | 19.5 | 109.6 | 71.4 |
| 705 TSS | 133.3 | 129.3 | 113.6 | 34.4 | 121.3 | 163.6 | 201.7 | 173.1 | 56.9 | 62.1 | 122.4 | 30.7 |
| 706 TOC | 84.3 | 74.2 | 91.0 | 120.7 | 140.3 | 144.0 | 80.6 | 179.9 | 55.3 | 73.0 | 106.2 | 36.0 |
| 707 COD | 256.9 | 246.9 | 233.4 | 224.2 | 401.4 | 666.5 | 131.0 | 920.0 | 277.3 | 222.3 | 346.0 | 231.6 |
| 708 BOD | 108.6 | 98.4 | 143.1 | 117.8 | 245.4 | 262.8 | 72.8 | 250.9 | 74.4 | 100.4 | 160.0 | 69.7 |

*Classicals in mg/L.

Table 15

Industrial Concentration Summary (μg/L)*

| | St. Louis | | Atlanta | | | |
|---|---|---|---|---|---|---|
| POLLUTANT | Frost | Brown | Surrey | DeFoors | Ensign | Average |
| 110 1,1-DICHLOROETHYLENE | .0 | .0 | 3.0 | 49.2 | 17.3 | 11.6 |
| 111 1,1-DICHLOROETHANE | .0 | .0 | 1.0 | 7.9 | .6 | 1.5 |
| 112 TRANS-1,2-DICHLOROETHYLENE | .2 | .0 | .1 | 56.8 | 13.0 | 11.7 |
| 113 CHLOROFORM | 19.8 | 6.7 | 5.0 | 19.6 | 7.5 | 12.0 |
| 114 1,2-DICHLOROETHANE | .0 | .0 | .0 | 1.9 | 1.6 | .6 |
| 115 1,1,1-TRICHLOROETHANE | 8.1 | .0 | 73.2 | 252.0 | 173.4 | 85.1 |
| 116 CARBON TETRACHLORIDE | .5 | .0 | 14.8 | 151.7 | 3.2 | 28.4 |
| 117 BROMODICHLOROMETHANE | 2.3 | 4.0 | .0 | .0 | .0 | 1.6 |
| 120 TRICHLOROETHYLENE | 22.5 | 19.2 | 4.0 | 67.6 | 18.2 | 25.4 |
| 121 BENZENE | 2.0 | .6 | .8 | 1.8 | 1.0 | 1.2 |
| 123 DIBROMOCHLOROMETHANE | 1.7 | 3.0 | .0 | .0 | .0 | 1.2 |
| 125 BROMOFORM | .0 | .0 | .0 | .0 | .0 | .0 |
| 127 1,1,2,2-TETRACHLOROETHYLENE | 17.1 | 14.4 | 123.9 | 204.8 | 43.5 | 69.9 |
| 128 TOLUENE | 5.4 | 29.6 | 123.8 | 63.3 | 74.2 | 52.3 |
| 129 CHLOROBENZENE | .0 | .0 | .0 | 5.6 | .0 | .9 |
| 130 ETHYL BENZENE | .5 | 1.9 | 258.3 | 228.9 | 111.9 | 100.4 |
| 203 PHENOL | 7.3 | .0 | 551.8 | 232.5 | 19.8 | 135.8 |
| 204 2,4-DIMETHYLPHENOL | .0 | .0 | 301.3 | 130.9 | 11.6 | 74.0 |
| 210 PENTACHLOROPHENOL | .0 | .0 | 9.2 | 51.3 | .0 | 10.1 |
| 301 DICHLOROBENZENES | 27.6 | 16.6 | .0 | 2187.7 | 5.2 | 376.5 |
| 315 NAPHTHALENE | 9.2 | 11.4 | 194.9 | 78.6 | .0 | 50.7 |
| 326 DIETHYL PHTHALATE | .0 | .0 | .0 | .0 | .0 | .0 |
| 333 DI-N-BUTYL PHTHALATE | 81.1 | 98.5 | 42.7 | 90.4 | .0 | 67.1 |
| 337 BUTYL BENZYL PHTHALATE | 17.6 | 1.1 | 604.0 | .0 | 377.3 | 168.2 |
| 338 BIS(2-ETHYLHEXYL)PHTHALATE | .0 | .0 | 173.7 | 84.1 | .0 | 43.0 |
| 501 ANTIMONY | 8.8 | .0 | | | | 1.7 |
| 502 ARSENIC | .0 | 5.8 | 2.0 | 8.5 | .0 | 3.2 |
| 504 CADMIUM | 10.8 | 4.0 | 17.1 | 1.7 | 83.5 | 20.7 |
| 505 CHROMIUM | 134.4 | 18.3 | 1880.6 | 2136.9 | 33.0 | 713.2 |
| 506 COPPER | 70.6 | 41.5 | 75.4 | 163.0 | 342.5 | 124.8 |
| 507 LEAD | 95.9 | 78.3 | 1224.5 | 365.2 | 91.4 | 323.7 |
| 508 MANGANESE | 205.0 | 60.3 | 165.5 | 388.1 | 441.2 | 232.1 |
| 509 MERCURY | .0 | .0 | 1.8 | 5.9 | 3.4 | 1.9 |
| 510 NICKEL | 10.3 | 5.8 | 596.7 | 22.1 | 8.8 | 108.7 |
| 511 SELENIUM | 3.0 | .4 | .0 | .0 | .0 | .9 |
| 512 SILVER | 2.8 | 567.2 | 8.3 | 25.7 | 13.6 | 150.4 |
| 513 THALLIUM | .3 | .0 | .0 | .0 | .0 | .1 |
| 514 ZINC | 652.3 | 122.4 | 3358.0 | 493.4 | 148.7 | 860.0 |
| 601 TOTAL CYANIDES | 56.2 | 1.7 | 236.4 | 48.8 | 172.4 | 90.7 |
| 602 TOTAL PHENOLS | 28.6 | 26.2 | 446.1 | 514.7 | 181.5 | 204.1 |
| 703 AMMONIA | 10.7 | 21.1 | 3.6 | 8.4 | 4.1 | 10.6 |
| 704 OIL AND GREASE | 21.6 | 5.5 | 430.7 | 103.4 | 62.0 | 106.1 |
| 705 TSS | 97.4 | 47.9 | 434.1 | 550.9 | 91.5 | 215.8 |
| 706 TOC | 80.1 | 38.1 | 196.3 | 273.4 | 133.9 | 130.1 |
| 707 COD | 192.6 | 144.3 | 1350.3 | 1068.0 | 318.2 | 540.3 |
| 708 BOD | 69.8 | 47.4 | 388.8 | 524.9 | 207.1 | 216.1 |

*Classicals in mg/L.

## Table 16

### POTW Influent Concentration Summary (μg/L)*

| POLLUTANT | Cincinnati | St. Louis | Atlanta | Hartford | Average |
|---|---|---|---|---|---|
| 110 1,1-DICHLOROETHYLENE | .0 | .9 | 8.6 | .0 | 2.4 |
| 111 1,1-DICHLOROETHANE | .0 | .3 | .0 | .0 | .1 |
| 112 TRANS-1,2-DICHLOROETHYLENE | .0 | .5 | 16.8 | .0 | 4.3 |
| 113 CHLOROFORM | 2.6 | 6.2 | 7.1 | 3.8 | 4.9 |
| 114 1,2-DICHLOROETHANE | .4 | .0 | .4 | .0 | .2 |
| 115 1,1,1-TRICHLOROETHANE | .3 | 9.3 | 95.9 | 10.3 | 28.9 |
| 116 CARBON TETRACHLORIDE | .0 | .0 | .0 | .0 | .0 |
| 117 BROMODICHLOROMETHANE | .0 | .7 | .0 | .0 | .2 |
| 120 TRICHLOROETHYLENE | .0 | 26.6 | 164.9 | 8.4 | 50.0 |
| 121 BENZENE | 3.7 | 7.0 | .0 | .0 | 2.7 |
| 123 DIBROMOCHLOROMETHANE | .0 | 1.0 | .0 | .0 | .2 |
| 125 BROMOFORM | .0 | .0 | .0 | .0 | .0 |
| 127 1,1,2,2-TETRACHLOROETHYLENE | 1.1 | 45.0 | 239.4 | 26.2 | 77.9 |
| 128 TOLUENE | 1.9 | 60.2 | 25.5 | 15.6 | 25.8 |
| 129 CHLOROBENZENE | .0 | .2 | .0 | .0 | .0 |
| 130 ETHYL BENZENE | .9 | 15.6 | 48.7 | .0 | 16.3 |
| 203 PHENOL | .0 | 10.5 | 18.6 | .0 | 7.3 |
| 204 2,4-DIMETHYLPHENOL | .0 | .0 | 9.9 | .0 | 2.5 |
| 210 PENTACHLOROPHENOL | 3.6 | .0 | 19.2 | .0 | 5.7 |
| 301 DICHLOROBENZENES | .0 | 26.1 | 92.7 | 13.4 | 33.1 |
| 315 NAPHTHALENE | 3.8 | 9.9 | 32.9 | .0 | 11.6 |
| 320 DIETHYL PHTHALATE | 11.6 | 7.0 | 5.0 | 3.6 | 6.8 |
| 333 DI-N-BUTYL PHTHALATE | 12.6 | 15.8 | 4.4 | 4.2 | 9.3 |
| 337 BUTYL BENZYL PHTHALATE | .0 | 11.4 | 77.3 | .0 | 22.2 |
| 338 BIS(2-ETHYLHEXYL)PHTHALATE | 4.5 | 4.3 | .0 | .0 | 2.2 |
| 501 ANTIMONY | .0 | 52.8 | .6 | .0 | 13.3 |
| 502 ARSENIC | 21.6 | .0 | .0 | 1.9 | 5.9 |
| 504 CADMIUM | 2.4 | 2.9 | 3.1 | .0 | 2.1 |
| 505 CHROMIUM | 151.6 | 135.4 | 72.1 | 65.4 | 106.1 |
| 506 COPPER | 62.1 | 46.6 | 50.4 | 96.6 | 63.9 |
| 507 LEAD | 15.9 | 210.2 | 135.6 | 35.6 | 99.3 |
| 508 MANGANESE | 342.4 | 201.6 | 277.5 | 158.0 | 244.9 |
| 509 MERCURY | .4 | .5 | .8 | .0 | .4 |
| 510 NICKEL | 34.8 | 45.8 | 18.3 | 35.0 | 33.5 |
| 511 SELENIUM | 5.3 | 4.3 | .0 | .0 | 2.4 |
| 512 SILVER | 3.7 | 16.0 | 12.4 | 3.1 | 8.8 |
| 513 THALLIUM | .0 | .0 | .0 | .0 | .0 |
| 514 ZINC | 372.0 | 290.6 | 353.2 | 157.4 | 293.3 |
| 601 TOTAL CYANIDES | 39.7 | 14.6 | 4.9 | 4.0 | 15.8 |
| 602 TOTAL PHENOLS | 24.8 | 60.8 | 99.8 | 52.5 | 59.5 |
| 703 AMMONIA | 13.9 | 17.0 | 7.4 | 9.4 | 11.9 |
| 704 OIL AND GREASE | 48.8 | 31.0 | 28.5 | 37.2 | 36.4 |
| 705 TSS | 104.9 | 124.8 | 137.9 | 76.9 | 111.1 |
| 706 TOC | 43.0 | 97.2 | 67.9 | 42.5 | 62.6 |
| 707 COD | 157.9 | 305.7 | 184.8 | 191.0 | 209.9 |
| 708 BOD | 47.6 | 154.6 | 100.9 | 68.1 | 92.8 |

*Classicals in mg/L.

# Table 17

## Residential Per Capita Mass Discharge Rate Summary (mg/person/day)*

| | Cincinnati | | St. Louis | | | Atlanta | | Hartford | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| POLLUTANT | Kirkridge | Elco | Eppingham | Avecado | Brightwell | Northside | Warren | Franklin | Hillside | Tunxis | Brentwood | Average | Standard Deviation |
| 110 1,1-DICHLOROETHYLENE | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 |
| 111 1,1-DICHLOROETHANE | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 |
| 112 TRANS-1,2-DICHLOROETHYLENE | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 |
| 113 CHLOROFORM | 1.5 | 4.0 | 1.2 | 1.3 | 1.4 | 2.4 | 1.5 | 2.4 | 5.4 | .0 | 1.6 | 2.1 | .6 |
| 114 1,2-DICHLOROETHANE | .0 | .0 | .0 | .0 | .3 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 |
| 115 1,1,1-TRICHLOROETHANE | .0 | .3 | 1.9 | .3 | .5 | .8 | .0 | .0 | 1.1 | .0 | 14.5 | 1.3 | 1.7 |
| 116 CARBON TETRACHLORIDE | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 |
| 117 BROMODICHLOROMETHANE | .0 | .2 | .0 | .0 | .1 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 |
| 120 TRICHLOROETHYLENE | .0 | .0 | .0 | .6 | .1 | 1.3 | .0 | .0 | .0 | .0 | .0 | .2 | .3 |
| 121 BENZENE | .0 | .4 | .3 | .1 | .7 | .0 | .0 | .0 | .0 | .0 | .0 | .1 | .1 |
| 123 DIBROMOCHLOROMETHANE | .0 | .1 | .0 | .0 | .1 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 |
| 125 BROMOFORM | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 |
| 127 1,1,2,2-TETRACHLOROETHYLENE | .4 | 2.7 | 4.9 | 5.9 | 6.9 | 5.5 | .4 | 2.8 | 1.0 | .3 | .4 | 3.3 | 2.7 |
| 128 TOLUENE | .5 | 7.0 | .6 | 2.1 | 5.2 | .9 | .1 | 1.4 | .0 | .0 | .0 | 1.8 | 1.7 |
| 129 CHLOROBENZENE | .0 | .3 | .0 | .0 | .1 | .0 | .0 | .0 | .0 | .0 | .0 | .1 | .1 |
| 130 ETHYL BENZENE | .2 | 1.2 | .0 | .0 | 1.5 | .0 | .1 | .0 | .0 | .0 | .0 | .3 | .4 |
| 203 PHENOL | 1.5 | 36.9 | .9 | 6.1 | 2.7 | .0 | 1.7 | .0 | .0 | .0 | .0 | 5.8 | 9.0 |
| 204 2,4-DIMETHYLPHENOL | .0 | 1.1 | .0 | .8 | .0 | .0 | 1.2 | .0 | .0 | .0 | .0 | .4 | .3 |
| 210 PENTACHLOROPHENOL | .0 | .0 | .0 | .0 | .0 | 6.2 | .0 | .0 | .0 | .0 | .0 | .8 | 1.6 |
| 301 DICHLOROBENZENES | .0 | .0 | .0 | 5.1 | 8.9 | .0 | .0 | .0 | .0 | .0 | .0 | 1.2 | 2.3 |
| 315 NAPHTHALENE | .0 | 1.9 | .0 | .0 | 8.4 | .0 | .0 | 3.8 | .0 | .0 | .0 | 1.2 | 1.7 |
| 326 DIETHYL PHTHALATE | 16.8 | 55.7 | 5.5 | 4.5 | 1.5 | .0 | .0 | .0 | .0 | .0 | 9.0 | 10.6 | 17.2 |
| 333 DI-N-BUTYL PHTHALATE | 18.6 | 20.5 | 3.5 | 9.5 | 3.1 | .0 | 1.6 | .0 | .0 | 13.6 | 1.9 | 7.4 | 8.3 |
| 337 BUTYL BENZYL PHTHALATE | 7.5 | 15.3 | 5.5 | 4.7 | 10.8 | .0 | .0 | .0 | .0 | .0 | 5.0 | 4.9 | 5.3 |
| 338 BIS(2-ETHYLHEXYL)PHTHALATE | 7.4 | 21.8 | 1.2 | .0 | 20.2 | .0 | .0 | .0 | .0 | .0 | .0 | 5.4 | 7.6 |
| 501 ANTIMONY | .0 | 5.0 | 5.2 | 4.9 | .0 | .0 | .6 | .0 | .0 | .0 | .0 | 1.6 | 1.7 |
| 502 ARSENIC | 19.6 | 24.9 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | 2.3 | 2.0 | 5.8 | 10.9 |
| 504 CADMIUM | .0 | .8 | .6 | .4 | 2.7 | .0 | .5 | .0 | .0 | .0 | 8.3 | 1.0 | .8 |
| 505 CHROMIUM | 8.5 | 36.3 | 4.4 | 3.0 | 4.5 | 15.5 | 2.3 | 61.0 | 15.4 | .0 | .0 | 13.6 | 8.6 |
| 506 COPPER | 139.5 | 149.2 | 17.8 | 14.1 | 60.9 | 24.7 | 10.3 | 54.3 | 47.6 | 56.9 | 40.2 | 60.7 | 57.2 |
| 507 LEAD | .0 | 74.9 | 23.0 | 21.7 | 346.2 | 26.7 | 13.4 | 32.5 | 6.0 | 12.3 | 17.5 | 51.2 | 53.5 |
| 508 MANGANESE | 84.6 | 105.1 | 82.7 | 87.3 | 46.9 | 115.6 | 79.4 | 57.3 | 231.7 | 59.7 | 72.0 | 104.9 | 80.1 |
| 509 MERCURY | .0 | .4 | .2 | .0 | .4 | .0 | .0 | .0 | .0 | .0 | .4 | .2 | .2 |
| 510 NICKEL | .0 | 6.3 | 4.1 | 3.2 | 4.4 | 1.9 | 1.8 | 2.0 | .0 | .0 | 1.0 | 2.4 | 1.4 |
| 511 SELENIUM | 3.9 | 8.2 | 3.2 | 5.4 | 3.8 | .0 | .0 | .0 | .0 | .5 | .0 | 2.7 | 3.0 |
| 512 SILVER | .7 | .1 | 1.9 | 4.5 | .3 | 3.5 | .0 | .0 | .0 | .0 | .0 | 1.1 | 1.0 |
| 513 THALLIUM | .0 | .0 | .3 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .4 |
| 514 ZINC | 130.7 | 205.[illegible] | 42.7 | 38.6 | 531.2 | 85.5 | 66.9 | 72.8 | 57.8 | 50.6 | 72.6 | 120.5 | 69.4 |
| 601 TOTAL CYANIDES | .0 | .4 | .4 | .0 | .9 | 4.8 | .0 | .0 | .0 | .0 | .0 | .7 | 1.2 |
| 602 TOTAL PHENOLS | 29.4 | 47.4 | 14.8 | 16.3 | 16.2 | 13.1 | 6.7 | 29.7 | 25.7 | .0 | 14.9 | 25.5 | 22.4 |
| 703 AMMONIA | 24.4 | 23.[illegible] | 1.7 | 8.4 | 7.3 | 5.0 | 2.9 | 3.4 | 2.9 | 7.2 | 7.4 | 11.6 | 11.4 |
| 704 OIL AND GREASE | 53.7 | 107.9 | 17.2 | 21.5 | 214.1 | 18.7 | 11.0 | 24.5 | 17.8 | 18.4 | 10.3 | 49.4 | 38.3 |
| 705 TSS | 151.1 | 310.5 | 42.3 | 53.2 | 64.6 | 49.3 | 95.0 | 32.6 | 21.3 | 35.9 | 114.2 | 127.6 | 137.4 |
| 706 TOC | 93.3 | 172.5 | 37.4 | 45.5 | 48.1 | 37.8 | 24.0 | 33.5 | 34.5 | 57.9 | 38.9 | 52.1 | 46.6 |
| 707 COD | 276.5 | 596.9 | 70.8 | 116.3 | 135.6 | 221.6 | 58.9 | 123.7 | 130.7 | 206.0 | 179.8 | 206.3 | 140.6 |
| 708 BOD | 117.6 | 775.0 | 48.1 | 73.0 | 69.9 | 48.6 | 29.1 | 43.5 | 19.0 | 70.0 | 62.8 | 76.2 | 72.5 |

*Classicals in g/person/day

## Table 18

## Overall Source Average Concentrations

| Pollutant | µg/L* RES | µg/L* COM | µg/L* IND |
|---|---|---|---|
| 110 1,1-*DICHLOROETHYLENE* | .0 | .3 | 11.6 |
| 111 1,1-*DICHLOROETHANE* | .0 | .1 | 1.6 |
| 112 *TRANS*-1,2-*DICHLOROETHYLENE* | .0 | 1.5 | 11.7 |
| 113 *CHLOROFORM* | 3.0 | 6.7 | 12.0 |
| 114 1,2-*DICHLOROETHANE* | .1 | .1 | .6 |
| 115 1,1,1-*TRICHLOROETHANE* | 2.3 | 2.9 | 85.1 |
| 116 *CARBON TETRACHLORIDE* | .0 | .1 | 28.4 |
| 117 *BROMODICHLOROMETHANE* | .0 | 1.0 | 1.6 |
| 120 *TRICHLOROETHYLENE* | .4 | 12.8 | 25.4 |
| 121 *BENZENE* | .2 | 2.7 | 1.2 |
| 123 *DIBROMOCHLOROMETHANE* | .0 | .7 | 1.2 |
| 125 *BROMOFORM* | .0 | .0 | .0 |
| 127 1,1,2,2-*TETRACHLOROETHYLENE* | 6.3 | 21.4 | 69.9 |
| 128 *TOLUENE* | 2.6 | 11.0 | 52.3 |
| 129 *CHLOROBENZENE* | .1 | .0 | .9 |
| 130 *ETHYL BENZENE* | .4 | 3.0 | 100.4 |
| 203 *PHENOL* | 5.8 | 4.5 | 135.8 |
| 204 2,4-*DIMETHYLPHENOL* | .7 | .0 | 74.0 |
| 210 *PENTACHLOROPHENOL* | 1.2 | 5.8 | 10.1 |
| 301 *DICHLOROBENZENES* | 2.8 | 7.5 | 376.5 |
| 315 *NAPHTHALENE* | 2.1 | 2.6 | 50.7 |
| 326 *DIETHYL PHTHALATE* | 9.8 | 5.7 | .0 |
| 333 *DI-N-BUTYL PHTHALATE* | 9.0 | 11.7 | 67.1 |
| 337 *BUTYL BENZYL PHTHALATE* | 6.8 | 10.6 | 168.2 |
| 338 *BIS(2-ETHYLHEXYL)PHTHALATE* | 6.8 | 7.7 | 43.0 |
| 501 *ANTIMONY* | 2.7 | .3 | 1.7 |
| 502 *ARSENIC* | 4.8 | 2.6 | 3.2 |
| 504 *CADMIUM* | 1.8 | .6 | 20.7 |
| 505 *CHROMIUM* | 16.3 | 56.8 | 713.2 |
| 506 *COPPER* | 72.1 | 54.5 | 124.8 |
| 507 *LEAD* | 97.3 | 49.8 | 323.7 |
| 508 *MANGANESE* | 153.0 | 224.8 | 232.1 |
| 509 *MERCURY* | .4 | .4 | 1.9 |
| 510 *NICKEL* | 4.2 | 12.4 | 108.7 |
| 511 *SELENIUM* | 3.8 | 3.3 | .9 |
| 512 *SILVER* | 2.2 | 2.9 | 150.4 |
| 513 *THALLIUM* | .0 | .1 | .1 |
| 514 *ZINC* | 214.0 | 138.1 | 860.0 |
| 601 *TOTAL CYANIDES* | 1.1 | .2 | 90.7 |
| 602 *TOTAL PHENOLS* | 30.8 | 37.0 | 204.1 |
| 703 *AMMONIA* | 14.2 | 10.7 | 10.6 |
| 704 *OIL AND GREASE* | 77.4 | 109.0 | 106.1 |
| 705 *TSS* | 156.8 | 122.4 | 215.8 |
| 706 *TOC* | 81.5 | 106.2 | 130.1 |
| 707 *COD* | 263.8 | 346.0 | 540.3 |
| 708 *BOD* | 113.9 | 160.0 | 216.1 |

*Classicals in mg/L.

## 2. Frequency/Concentration Relationships

For each pollutant, the frequency of detection data (in percent) have been paired with the average category concentration data by source category and is summarized in Table 19. For simplification in attempting to interpret this data, they have been grouped into general categories; pollutants detected greater than or less than 50 percent of the time, in concentration level groups of <10 µg/L, 10-100 µg/L and >100 µg/L. These results were shown in Figure 1-5 of the Summary.

These displays clearly show the low levels of pollutants associated with tap water and the increase in contribution from residential to commercial to industrial sources. The POTW influent data do reflect the integration of these results as indicated by presence of most of the detected pollutants, but at lower levels than the industrial sources and with greater overall frequency.

# Table 19

## Detection Frequency/Concentration[*] Summary

| | TAP | | RES | | COM | | IND | | INF | |
|---|---|---|---|---|---|---|---|---|---|---|
| | % Occurrence | Average Conc. | % Occurrence | Average Conc. | % Occurrence | Average Conc. | % Occurrence | Average Conc. | % Occurrence | Average Conc. |
| 110. 1,1-Dichloroethylene | 0 | 0 | 0 | 0 | 5 | 0.3 | 38 | 11.6 | 17 | 2.4 |
| 111. 1,1-Dichloroethane | 0 | 0 | 0 | 0 | 2 | 0.1 | 33 | 1.6 | 6 | 0.1 |
| 112. Trans-1,2-dichloroethylene | 0 | 0 | 0 | 0 | 43 | 1.5 | 38 | 11.7 | 28 | 4.8 |
| 113. Chloroform | 100 | 27.1 | 91 | 3.0 | 100 | 6.7 | 100 | 12.0 | 100 | 4.9 |
| 114. 1,2-Dichloroethane | 0 | 0 | 2 | 0.1 | 5 | 0.1 | 14 | 0.6 | 11 | 0.2 |
| 115. 1,1,1-Trichloroethane | 0 | 0 | 30 | 2.3 | 52 | 2.9 | 71 | 85.1 | 78 | 28.9 |
| 116. Carbon tetrachloride | 0 | 0 | 0 | 0 | 5 | 0.1 | 33 | 28.4 | 0 | 0 |
| 117. Bromodichloromethane | 100 | 8.8 | 4 | 0 | 50 | 1.0 | 57 | 1.6 | 11 | 0.2 |
| 120. Trichloroethylene | 0 | 0 | 11 | 0.4 | 14 | 12.8 | 100 | 25.4 | 67 | 50.5 |
| 121. Benzene | 0 | 0 | 22 | 0.2 | 50 | 2.7 | 76 | 1.2 | 67 | 2.7 |
| 123. Dibromochloromethane | 58 | 5.9 | 4 | 0 | 43 | 0.7 | 57 | 1.2 | 22 | 0.2 |
| 125. Bromoform | 33 | 0.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 127. 1,1,2,2-Tetrachloroethylene | 25 | 0.8 | 78 | 6.3 | 98 | 21.4 | 100 | 69.9 | 83 | 77.9 |
| 128. Toluene | 8 | 0.3 | 63 | 2.6 | 90 | 11.0 | 100 | 52.3 | 78 | 25.8 |
| 129. Chlorobenzene | 0 | 0 | 7 | 0.1 | 5 | 0 | 14 | 0.9 | 6 | 0 |
| 130. Ethylbenzene | 8 | 0.1 | 17 | 0.4 | 50 | 3.0 | 76 | 100.4 | 67 | 16.3 |
| 203. Phenol | 0 | 0 | 38 | 5.8 | 40 | 4.5 | 52 | 135.8 | 33 | 7.3 |
| 204. 2,4-Dimethylphenol | 0 | 0 | 6 | 0.7 | 0 | 0 | 38 | 74.0 | 11 | 2.5 |
| 210. Pentachlorophenol | 0 | 0 | 4 | 1.2 | 14 | 5.8 | 19 | 10.1 | 22 | 5.7 |
| 301. Dichlorobenzenes | 0 | 0 | 13 | 2.8 | 31 | 7.5 | 57 | 376.5 | 56 | 33.1 |
| 315. Naphthalene | 0 | 0 | 9 | 2.1 | 17 | 2.6 | 62 | 50.7 | 44 | 11.6 |
| 326. Diethylphthalate | 8 | 0.8 | 49 | 9.8 | 36 | 5.7 | 0 | 0 | 50 | 6.8 |
| 333. Di-n-butylphthalate | 25 | 4.5 | 34 | 9.0 | 43 | 11.7 | 57 | 67.1 | 67 | 9.3 |
| 337. Butylbenzylphthalate | 0 | 0 | 47 | 6.8 | 55 | 10.6 | 52 | 168.2 | 44 | 22.2 |
| 338. Bis(2-ethylhexyl)/di-n-octyl phthalate | 17 | 4.1 | 23 | 6.8 | 38 | 7.7 | 24 | 43.0 | 22 | 2.2 |
| 501. Antimony | 17 | 3.0 | 35 | 2.7 | 7 | 0.3 | 50 | 1.7 | 39 | 13.3 |
| 502. Arsenic | 25 | 1.6 | 35 | 4.8 | 38 | 2.6 | 43 | 3.2 | 44 | 5.9 |
| 504. Cadmium | 8 | 0.5 | 15 | 1.8 | 12 | 0.6 | 38 | 20.7 | 56 | 2.1 |
| 505. Chromium | 8 | 2.5 | 63 | 16.3 | 59 | 56.8 | 100 | 713.2 | 89 | 106.1 |
| 506. Copper | 92 | 28.4 | 100 | 72.1 | 100 | 54.5 | 100 | 124.8 | 100 | 63.9 |
| 507. Lead | 33 | 10.4 | 83 | 97.3 | 83 | 49.8 | 100 | 323.7 | 89 | 99.3 |
| 508. Manganese | 50 | 5.1 | 100 | 153.0 | 100 | 224.8 | 100 | 232.1 | 100 | 244.9 |
| 509. Mercury | 0 | 0 | 17 | 0.4 | 10 | 0.4 | 33 | 1.9 | 17 | 0.4 |
| 510. Nickel | 25 | 4.3 | 61 | 4.2 | 79 | 12.4 | 100 | 108.7 | 83 | 33.5 |
| 511. Selenium | 33 | 2.9 | 57 | 3.8 | 38 | 3.3 | 14 | 0.9 | 28 | 2.4 |
| 512. Silver | 8 | 0.3 | 22 | 2.2 | 51 | 2.9 | 86 | 150.4 | 94 | 8.8 |
| 513. Thallium | 0 | 0 | 0 | 0 | 10 | 0.1 | 5 | 0.1 | 0 | 0 |
| 514. Zinc | 58 | 66.9 | 100 | 214.0 | 100 | 138.1 | 100 | 860.0 | 100 | 293.3 |
| 601. Total Cyanides | 0 | 0 | 4 | 1.1 | 2 | 0.2 | 76 | 90.7 | 61 | 15.8 |
| 602. Total Phenols | 17 | 2.0 | 93 | 30.8 | 95 | 37.0 | 100 | 204.1 | 100 | 59.5 |

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[*] μg/L.

## C. Mass Flow Analysis

One of the objectives of this study is to be able to predict the relative mass contribution of residential and commercial sources, in particular, to POTW influents. One reason for doing this is to estimate the industrial contribution at any given POTW by measurement of its influent. The total mass flow to the POTW for any pollutant may be expressed as:

$$\text{POTW} = \text{RES} + \text{COM} + \text{IND} + \text{OTHER}$$

representing the total mass flow (e.g., in Kg/day) to the POTW from each of the three major source categories and inflow/infiltration, runoff, etc. Because it was not possible to measure the "other" values during this study, it has deliberately not been included. The impact of the "other" sources is, of course, implicitly included in unknown proportions in the data from each of the categories. Therefore, for the purposes of this study the total POTW mass flow has been represented by:

$$\text{POTW} = \text{RES} + \text{COM} + \text{IND}$$

For any new city, Q, if the total contribution from the residential and commercial sources can be estimated, then the industrial contribution can be calculated after measuring the POTW as follows:

$$\text{IND}_Q = \text{POTW}_Q - (\text{RES}_Q + \text{COM}_Q).$$

One means of checking the validity of the data, as it is being developed, is to carry out a mass balance calculation for the city (z) being studied by adding the relative contributions from each source type for comparison with the POTW:

$$\text{POTW}_z = \text{RES}_z + \text{COM}_z + \text{IND}_z.$$

These goals could be attained if it were possible to determine an average index value (V) for each source category which could be scaled up for each POTW basin according to the relative amount of each type of source activity in the basin (A). In the general case, the equation would take the form

$$\text{POTW} = V_R A_R + V_C A_C + V_I A_I$$

indicating the quantities of each source type (R = RES, C = COM, I = IND).

The basic data available from each sampling site to use in developing this approach is concentration, flow, and population. For the POTW service area as a whole, it is usually possible to obtain reliable estimates of total population (from the land planning agency) and total commercial and industrial flow (from the water use records).

For the residential sites, it is reasonable to use the population as an index basis. Thus, for the residential sites, a per capita discharge rate can be calculated as follows:

$$\text{mass/person/day} = \frac{\text{concentration x flow}}{\text{population}}$$

For reporting convenience, the residential values have been developed in units of mg/person/day. The total basin residential contribution may thus be estimated as:

$$\text{RES(Kg/day)} = \text{Res. Ave. (mg/person/day) x Basin Population x } 10^{-6}$$

$$(10^{6} \text{ is the } \mu\text{g to Kg conversion factor})$$

For the commercial and industrial sites, the only index reliably available for all of the sites studied (and the basin) is the total flow. Thus, for these source types, an average concentration value has been calculated so that, when the average value is multiplied by the total basin source type flow, the total source contribution is obtained:

$$\text{COM (Kg/day)} = [\text{Avg. Com. Conc. } (\mu\text{g/L})] \text{ x } [\text{Com. Flow(Lps)}] \text{ x } 8.64 \text{ x } 10^{-5}$$

$$\text{IND(Kg/day)} = [\text{Avg. Ind. Conc. } (\mu\text{g/L})] \text{ x } [\text{Ind. Flow(Lps)}] \text{ x } 8.64 \text{ x } 10^{-5}$$

$$(8.64 \text{ x } 10^{-5} \text{ is the } \mu\text{g/sec to Kg/day conversion factor})$$

The data obtained from the commercial sites do not show a wide range in type or quantity of pollutant between sites and suggest that an average commercial concentration is a valid concept. To the contrary, the industrial site data show a wide range of both types and concentration of pollutant indicating that an average industrial concentration is not a valid concept which can be applied generally. It is useful, however, within a basin to calculate this value so that a mass balance comparison between the sources and POTW may be made. Such a comparison provides a test of how well the sites sampled represent, quantitatively and qualitatively, the total of that source type within the basin.

The average index values (Tables 14,15,17) may be used to calculate the total mass flow from each of the source types within the drainage basic according to the equation:

$$\text{SUM} = \text{RES} \times \text{Population} + \text{COM} \times \text{Flow}_C + \text{IND} \times \text{Flow}_I$$

where RES, COM, and IND indicate the average value either on a per capita or concentration basis; population refers to the total drainage basin population; and $\text{Flow}_C$ and $\text{Flow}_I$ are, respectively, the total commercial and industrial flows in the basin. The values thus calculated may be compared with the POTW influent.

Two sets of analyses have been carried out using this approach. The first involved using the average values to calculate the relative significance of each source type for several hypothetical cities varying in degree of industrialization and residential/commercial mix. The second involved using the four city average values to calculate a total influent flow (SUM) to compare with the actual measured value for each of the cities studied.

Residential source averaging was done assuming that sites within a city were all part of the same overall statistical population and, therefore, the average residential value for each city was calculated on a per capita weighted basis. The assumption of homogeneity within a city's population implies that each site's population is a proper measure of that site's ability to represent the residences in the basin as a whole, allowing population weighted averages within a city.

For commercial and industrial sources, average concentration values were calculated as straight averages of sites to form city averages and as straight averages of city means to form an overall average. The assumption is that for commercial and industrial sources, different sites represent different aspects of the source type and, therefore, different sites are not from a single statistical population. Average residential values across cities were straight averaged on the assumption that the individual cities represent samples from different statistical populations.

### 1. Hypothetical Cities

One means of obtaining a perspective on the significance of relative source type contributions to POTW influents is to use the average data obtained in this study to calculate mass flows for several hypothetical cities. Such an analysis has been carried out for five cases (A, B, C, D, E) using the distribution of flow and population described in Table 20. These cases represent a range of industrialization of 0-50% (in terms of flow) and a residential flow of 90-30% (200,000-68,000 population) with varying levels of commercial activity (10-20%). The Case B distribution is about the same as was observed in St. Louis.

A review of influent flow for 324 POTWs having secondary treatment showed an overall average flow of about 1,000 Lps and this value was used for these Case calculations. Those same plants also had an average industrial flow of about 20%. The Case E example was calculated to represent this "typical" basin.

The calculations for these prototype cities are given in Tables 21-25. The relative impact of the sources changes between these Cases is perhaps seen most easily by comparing the ratios of the source categories to that with the highest value. Those ratios are given in Tables 26-30 for Cases A, B, C, D, and E, respectively.

The dominance of the residential category in Case A is obvious, with commercial sources dominant for only eight toxic pollutants. Commercial sources still play a small role in Case B, but the impact of even a small degree of industrialization is clear. This trend continues for Cases C, D, and E where the industrial category is dominant for most pollutants.

The overall impact of these source distribution changes can be seen further in Table 31, where the total mass flow (SUM) for each case is compared. Much higher mass flows are observed for most pollutants in Case D than in Case A. However, some pollutants, whose concentrations are not strongly source dependent, such as manganese, do not change much across the cases. Once again, the trends in these data for each pollutant can be seen in the ratios given in Table 32.

Some pollutants still have the highest mass flows in the most residential cases--diethyl phthalate, copper, and manganese, for instance. The reader is reminded to use these analyses with caution because they are limited in terms of estimating the industrial impact, based on the data from the industrial sources sampled during the study.

For each of these hypothetical cases with an influent flow of 1,000 Lps, a 1 μg/L influent concentration would correspond to a mass flow of 0.08 Kg/day.

## Table 20

### Description of Hypothetical City Source Contribution

| CITY | TOTAL FLOW (Lps) | | RES | COM | IND |
|---|---|---|---|---|---|
| Case A | 1,000 | %<br>flow<br>pop. | 90<br>900<br>200,000 | 10<br>100<br>- | 0<br>0<br>- |
| Case B | 1,000 | %<br>flow<br>pop. | 80<br>800<br>182,000 | 10<br>100<br>- | 10<br>100<br>- |
| Case C | 1,000 | %<br>flow<br>pop. | 50<br>500<br>114,000 | 20<br>200<br>- | 30<br>300<br>- |
| Case D | 1,000 | %<br>flow<br>pop. | 30<br>300<br>68,000 | 20<br>200<br>- | 50<br>500<br>- |
| Case E | 1,000 | %<br>flow<br>pop. | 60<br>600<br>136,500 | 20<br>200<br>- | 20<br>200<br>- |

## Table 21

### Hypothetical City - Case A - Mass Flow
### RES = 200,000 people, COM = 100 Lps, IND = 0 Lps

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| Pollutant | RES | COM | IND | SUM |
|---|---|---|---|---|
| | Kg/day* | | | |
| 110 1,1-*DICHLOROETHYLENE* | .00 | .00 | .00 | .00 |
| 111 1,1-*DICHLOROETHANE* | .00 | .00 | .00 | .00 |
| 112 *TRANS*-1,2-*DICHLOROETHYLENE* | .00 | .01 | .00 | .01 |
| 113 *CHLOROFORM* | .39 | .06 | .00 | .45 |
| 114 1,2-*DICHLOROETHANE* | .00 | .00 | .00 | .00 |
| 115 1,1,1-*TRICHLOROETHANE* | .10 | .03 | .00 | .13 |
| 116 *CARBON TETRACHLORIDE* | .00 | .00 | .00 | .00 |
| 117 *BROMODICHLOROMETHANE* | .01 | .01 | .00 | .01 |
| 120 *TRICHLOROETHYLENE* | .10 | .11 | .00 | .21 |
| 121 *BENZENE* | .02 | .02 | .00 | .05 |
| 123 *DIBROMOCHLOROMETHANE* | .00 | .01 | .00 | .01 |
| 125 *BROMOFORM* | .00 | .00 | .00 | .00 |
| 127 1,1,2,2-*TETRACHLOROETHYLENE* | .85 | .18 | .00 | 1.03 |
| 128 *TOLUENE* | .39 | .09 | .00 | .48 |
| 129 *CHLOROBENZENE* | .01 | .00 | .00 | .01 |
| 130 *ETHYL BENZENE* | .05 | .03 | .00 | .08 |
| 203 *PHENOL* | 1.26 | .04 | .00 | 1.30 |
| 204 2,4-*DIMETHYLPHENOL* | .08 | .00 | .00 | .08 |
| 210 *PENTACHLOROPHENOL* | .33 | .05 | .00 | .38 |
| 301 *DICHLOROBENZENES* | .28 | .07 | .00 | .34 |
| 315 *NAPHTHALENE* | .12 | .02 | .00 | .14 |
| 326 *DIETHYL PHTHALATE* | 2.35 | .05 | .00 | 2.40 |
| 333 *DI-N-BUTYL PHTHALATE* | 1.77 | .10 | .00 | 1.87 |
| 337 *BUTYL BENZYL PHTHALATE* | 1.07 | .09 | .00 | 1.16 |
| 338 *BIS(2-ETHYLHEXYL)PHTHALATE* | 1.04 | .07 | .00 | 1.11 |
| 501 *ANTIMONY* | .42 | .00 | .00 | .42 |
| 502 *ARSENIC* | 1.43 | .02 | .00 | 1.45 |
| 504 *CADMIUM* | .08 | .00 | .00 | .08 |
| 505 *CHROMIUM* | 2.34 | .49 | .00 | 2.83 |
| 506 *COPPER* | 12.38 | .47 | .00 | 12.85 |
| 507 *LEAD* | 7.73 | .43 | .00 | 8.16 |
| 508 *MANGANESE* | 21.17 | 1.94 | .00 | 23.12 |
| 509 *MERCURY* | .05 | .00 | .00 | .05 |
| 510 *NICKEL* | .52 | .11 | .00 | .62 |
| 511 *SELENIUM* | .68 | .03 | .00 | .70 |
| 512 *SILVER* | .45 | .03 | .00 | .47 |
| 513 *THALLIUM* | .00 | .00 | .00 | .00 |
| 514 *ZINC* | 23.05 | 1.19 | .00 | 24.24 |
| 601 *TOTAL CYANIDES* | .27 | .00 | .00 | .27 |
| 602 *TOTAL PHENOLS* | 5.23 | .32 | .00 | 5.55 |
| 703 *AMMONIA* | 2.73 | .09 | .00 | 2.82 |
| 704 *OIL AND GREASE* | 9.08 | .94 | .00 | 10.02 |
| 705 *TSS* | 26.21 | 1.06 | .00 | 27.27 |
| 706 *TOC* | 13.41 | .92 | .00 | 14.33 |
| 707 *COD* | 45.73 | 2.99 | .00 | 48.72 |
| 708 *BOD* | 19.02 | 1.38 | .00 | 20.40 |

*Classicals in $10^3$ kg/day.

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## Table 22

### Hypothetical City - Case B - Mass Flow
RES = 182,000 people, COM = 100 Lps, IND = 100 Lps

| Pollutant | Kg/day* RES | COM | IND | SUM |
|---|---|---|---|---|
| 110 1,1-*DICHLOROETHYLENE* | .00 | .00 | .10 | .10 |
| 111 1,1-*DICHLOROETHANE* | .00 | .00 | .01 | .01 |
| 112 *TRANS*-1,2-*DICHLOROETHYLENE* | .00 | .01 | .10 | .11 |
| 113 *CHLOROFORM* | .36 | .06 | .10 | .52 |
| 114 1,2-*DICHLOROETHANE* | .00 | .00 | .01 | .01 |
| 115 1,1,1-*TRICHLOROETHANE* | .09 | .03 | .74 | .85 |
| 116 *CARBON TETRACHLORIDE* | .00 | .00 | .25 | .25 |
| 117 *BROMODICHLOROMETHANE* | .01 | .01 | .01 | .03 |
| 120 *TRICHLOROETHYLENE* | .09 | .11 | .22 | .42 |
| 121 *BENZENE* | .02 | .02 | .01 | .06 |
| 123 *DIBROMOCHLOROMETHANE* | .00 | .01 | .01 | .02 |
| 125 *BROMOFORM* | .00 | .00 | .00 | .00 |
| 127 1,1,2,2-*TETRACHLOROETHYLENE* | .77 | .18 | .60 | 1.56 |
| 128 *TOLUENE* | .35 | .09 | .45 | .90 |
| 129 *CHLOROBENZENE* | .01 | .00 | .01 | .02 |
| 130 *ETHYL BENZENE* | .05 | .03 | .87 | .94 |
| 203 *PHENOL* | 1.14 | .04 | 1.17 | 2.36 |
| 204 2,4-*DIMETHYLPHENOL* | .07 | .00 | .64 | .71 |
| 210 *PENTACHLOROPHENOL* | .30 | .05 | .09 | .44 |
| 301 *DICHLOROBENZENES* | .25 | .07 | 3.25 | 3.57 |
| 315 *NAPHTHALENE* | .11 | .02 | .44 | .57 |
| 326 *DIETHYL PHTHALATE* | 2.14 | .05 | .00 | 2.19 |
| 333 *DI-N-BUTYL PHTHALATE* | 1.61 | .10 | .58 | 2.29 |
| 337 *BUTYL BENZYL PHTHALATE* | .97 | .09 | 1.45 | 2.52 |
| 338 *BIS*(2-*ETHYLHEXYL*)*PHTHALATE* | .95 | .07 | .37 | 1.38 |
| 501 *ANTIMONY* | .38 | .00 | .01 | .40 |
| 502 *ARSENIC* | 1.30 | .02 | .03 | 1.35 |
| 504 *CADMIUM* | .07 | .00 | .18 | .25 |
| 505 *CHROMIUM* | 2.13 | .49 | 6.16 | 8.79 |
| 506 *COPPER* | 11.26 | .47 | 1.08 | 12.81 |
| 507 *LEAD* | 7.03 | .43 | 2.80 | 10.26 |
| 508 *MANGANESE* | 19.27 | 1.94 | 2.01 | 23.22 |
| 509 *MERCURY* | .05 | .00 | .02 | .07 |
| 510 *NICKEL* | .47 | .11 | .94 | 1.52 |
| 511 *SELENIUM* | .61 | .03 | .01 | .65 |
| 512 *SILVER* | .41 | .03 | 1.30 | 1.73 |
| 513 *THALLIUM* | .00 | .00 | .00 | .00 |
| 514 *ZINC* | 20.97 | 1.19 | 7.43 | 29.60 |
| 601 *TOTAL CYANIDES* | .24 | .00 | .78 | 1.03 |
| 602 *TOTAL PHENOLS* | 4.76 | .32 | 1.76 | 6.84 |
| 703 *AMMONIA* | 2.48 | .09 | .09 | 2.67 |
| 704 *OIL AND GREASE* | 8.26 | .94 | .92 | 10.12 |
| 705 *TSS* | 23.85 | 1.06 | 1.86 | 26.77 |
| 706 *TOC* | 12.21 | .92 | 1.12 | 14.25 |
| 707 *COD* | 41.62 | 2.99 | 4.67 | 49.27 |
| 708 *BOD* | 17.31 | 1.38 | 1.87 | 20.56 |

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*Classicals in $10^3$ kg/day.

## Table 23

### Hypothetical City - Case C - Mass Flow
RES = 114,000 people, COM = 200 Lps, IND = 300 Lps

| Pollutant | Kg/day* RES | COM | IND | SUM |
|---|---|---|---|---|
| 110 1,1-DICHLOROETHYLENE | .00 | .00 | .30 | .30 |
| 111 1,1-DICHLOROETHANE | .00 | .00 | .04 | .04 |
| 112 TRANS-1,2-DICHLOROETHYLENE | .00 | .03 | .30 | .33 |
| 113 CHLOROFORM | .22 | .12 | .31 | .65 |
| 114 1,2-DICHLOROETHANE | .00 | .00 | .02 | .02 |
| 115 1,1,1-TRICHLOROETHANE | .06 | .05 | 2.21 | 2.32 |
| 116 CARBON TETRACHLORIDE | .00 | .00 | .74 | .74 |
| 117 BROMODICHLOROMETHANE | .00 | .02 | .04 | .06 |
| 120 TRICHLOROETHYLENE | .06 | .22 | .66 | .94 |
| 121 BENZENE | .01 | .05 | .03 | .09 |
| 123 DIBROMOCHLOROMETHANE | .00 | .01 | .03 | .04 |
| 125 BROMOFORM | .00 | .00 | .00 | .00 |
| 127 1,1,2,2-TETRACHLOROETHYLENE | .48 | .37 | 1.81 | 2.66 |
| 128 TOLUENE | .22 | .19 | 1.36 | 1.76 |
| 129 CHLOROBENZENE | .01 | .00 | .02 | .03 |
| 130 ETHYL BENZENE | .03 | .05 | 2.60 | 2.69 |
| 203 PHENOL | .72 | .08 | 3.52 | 4.31 |
| 204 2,4-DIMETHYLPHENOL | .04 | .00 | 1.92 | 1.96 |
| 210 PENTACHLOROPHENOL | .19 | .10 | .26 | .55 |
| 301 DICHLOROBENZENES | .16 | .13 | 9.76 | 10.05 |
| 315 NAPHTHALENE | .07 | .05 | 1.32 | 1.43 |
| 326 DIETHYL PHTHALATE | 1.34 | .10 | .00 | 1.44 |
| 333 DI-N-BUTYL PHTHALATE | 1.01 | .20 | 1.74 | 2.95 |
| 337 BUTYL BENZYL PHTHALATE | .61 | .18 | 4.36 | 5.15 |
| 338 BIS(2-ETHYLHEXYL)PHTHALATE | .59 | .13 | 1.11 | 1.84 |
| 501 ANTIMONY | .24 | .01 | .04 | .29 |
| 502 ARSENIC | .82 | .04 | .08 | .94 |
| 504 CADMIUM | .04 | .01 | .54 | .59 |
| 505 CHROMIUM | 1.34 | .98 | 18.49 | 20.80 |
| 506 COPPER | 7.05 | .94 | 3.24 | 11.23 |
| 507 LEAD | 4.41 | .86 | 8.39 | 13.66 |
| 508 MANGANESE | 12.07 | 3.88 | 6.02 | 21.97 |
| 509 MERCURY | .03 | .01 | .05 | .08 |
| 510 NICKEL | .29 | .21 | 2.82 | 3.33 |
| 511 SELENIUM | .38 | .06 | .02 | .46 |
| 512 SILVER | .25 | .05 | 3.90 | 4.20 |
| 513 THALLIUM | .00 | .00 | .00 | .00 |
| 514 ZINC | 13.14 | 2.39 | 22.29 | 37.81 |
| 601 TOTAL CYANIDES | .15 | .00 | 2.35 | 2.51 |
| 602 TOTAL PHENOLS | 2.98 | .64 | 5.29 | 8.91 |
| 703 AMMONIA | 1.55 | .18 | .28 | 2.02 |
| 704 OIL AND GREASE | 5.17 | 1.88 | 2.75 | 9.81 |
| 705 TSS | 14.94 | 2.12 | 5.59 | 22.65 |
| 706 TOC | 7.65 | 1.83 | 3.37 | 12.85 |
| 707 COD | 26.07 | 5.98 | 14.00 | 46.05 |
| 708 BOD | 10.84 | 2.76 | 5.60 | 19.21 |

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*Classicals in $10^3$ kg/day.

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## Table 24

### Hypothetical City - Case D - Mass Flow
RES = 68,000 people, COM = 200 Lps, IND = 500 Lps

| | Kg/day* | | | |
|---|---|---|---|---|
| | RES | COM | IND | SUM |
| 110 1,1-DICHLOROETHYLENE | .00 | .00 | .50 | .50 |
| 111 1,1-DICHLOROETHANE | .00 | .00 | .07 | .07 |
| 112 TRANS-1,2-DICHLOROETHYLENE | .00 | .03 | .51 | .53 |
| 113 CHLOROFORM | .13 | .12 | .52 | .77 |
| 114 1,2-DICHLOROETHANE | .00 | .00 | .03 | .03 |
| 115 1,1,1-TRICHLOROETHANE | .03 | .05 | 3.68 | 3.76 |
| 116 CARBON TETRACHLORIDE | .00 | .00 | 1.23 | 1.23 |
| 117 BROMODICHLOROMETHANE | .00 | .02 | .07 | .09 |
| 120 TRICHLOROETHYLENE | .03 | .22 | 1.10 | 1.35 |
| 121 BENZENE | .01 | .05 | .05 | .11 |
| 123 DIBROMOCHLOROMETHANE | .00 | .01 | .05 | .06 |
| 125 BROMOFORM | .00 | .00 | .00 | .00 |
| 127 1,1,2,2-TETRACHLOROETHYLENE | .29 | .37 | 3.02 | 3.68 |
| 128 TOLUENE | .13 | .19 | 2.26 | 2.58 |
| 129 CHLOROBENZENE | .00 | .00 | .04 | .04 |
| 130 ETHYL BENZENE | .02 | .05 | 4.34 | 4.41 |
| 203 PHENOL | .43 | .08 | 5.87 | 6.37 |
| 204 2,4-DIMETHYLPHENOL | .03 | .00 | 3.19 | 3.22 |
| 210 PENTACHLOROPHENOL | .11 | .10 | .44 | .65 |
| 301 DICHLOROBENZENES | .09 | .13 | 16.27 | 16.49 |
| 315 NAPHTHALENE | .04 | .05 | 2.19 | 2.28 |
| 326 DIETHYL PHTHALATE | .80 | .10 | .00 | .90 |
| 333 DI-N-BUTYL PHTHALATE | .60 | .20 | 2.90 | 3.70 |
| 337 BUTYL BENZYL PHTHALATE | .36 | .18 | 7.27 | 7.81 |
| 338 BIS(2-ETHYLHEXYL)PHTHALATE | .35 | .13 | 1.86 | 2.34 |
| 501 ANTIMONY | .14 | .01 | .07 | .22 |
| 502 ARSENIC | .49 | .04 | .14 | .67 |
| 504 CADMIUM | .03 | .01 | .90 | .93 |
| 505 CHROMIUM | .80 | .98 | 30.81 | 32.59 |
| 506 COPPER | 4.21 | .94 | 5.39 | 10.54 |
| 507 LEAD | 2.63 | .86 | 13.98 | 17.47 |
| 508 MANGANESE | 7.20 | 3.88 | 10.03 | 21.11 |
| 509 MERCURY | .12 | .01 | .08 | .10 |
| 510 NICKEL | .18 | .21 | 4.69 | 5.08 |
| 511 SELENIUM | .23 | .06 | .04 | .32 |
| 512 SILVER | .15 | .05 | 6.50 | 6.70 |
| 513 THALLIUM | .00 | .00 | .00 | .01 |
| 514 ZINC | 7.84 | 2.39 | 37.15 | 47.37 |
| 601 TOTAL CYANIDES | .09 | .00 | 3.92 | 4.01 |
| 602 TOTAL PHENOLS | 1.78 | .64 | 8.82 | 11.23 |
| 703 AMMONIA | .93 | .18 | .46 | 1.57 |
| 704 OIL AND GREASE | 3.09 | 1.88 | 4.59 | 9.56 |
| 705 TSS | 8.91 | 2.12 | 9.32 | 20.35 |
| 706 TOC | 4.56 | 1.83 | 5.62 | 12.02 |
| 707 COD | 15.55 | 5.98 | 23.34 | 44.87 |
| 708 BOD | 6.47 | 2.76 | 9.34 | 18.57 |

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*Classicals in $10^3$ kg/day.

## Table 25

### Hypothetical City - Case E - Mass Flow
RES = 136,500 people, COM = 200 Lps, IND - 200 Lps

| | Kg/day* | | | |
|---|---|---|---|---|
| Pollutant | RES | COM | IND | SUM |
| 110 1,1-*DICHLOROETHYLENE* | .00 | .00 | .20 | .20 |
| 111 1,1-*DICHLOROETHANE* | .00 | .00 | .03 | .03 |
| 112 *TRANS*-1,2-*DICHLOROETHYLENE* | .00 | .03 | .20 | .23 |
| 113 *CHLOROFORM* | .27 | .12 | .21 | .59 |
| 114 1,2-*DICHLOROETHANE* | .00 | .00 | .01 | .01 |
| 115 1,1,1-*TRICHLOROETHANE* | .07 | .05 | 1.47 | 1.59 |
| 116 *CARBON TETRACHLORIDE* | .00 | .00 | .49 | .49 |
| 117 *BROMODICHLOROMETHANE* | .00 | .02 | .03 | .05 |
| 120 *TRICHLOROETHYLENE* | .07 | .22 | .44 | .73 |
| 121 *BENZENE* | .02 | .05 | .02 | .08 |
| 123 *DIBROMOCHLOROMETHANE* | .00 | .01 | .02 | .04 |
| 125 *BROMOFORM* | .00 | .00 | .00 | .00 |
| 127 1,1,2,2-*TETRACHLOROETHYLENE* | .58 | .37 | 1.21 | 2.16 |
| 128 *TOLUENE* | .26 | .19 | .90 | 1.36 |
| 129 *CHLOROBENZENE* | .01 | .00 | .02 | .02 |
| 130 *ETHYL BENZENE* | .04 | .05 | 1.74 | 1.82 |
| 203 *PHENOL* | .86 | .08 | 2.35 | 3.28 |
| 204 2,4-*DIMETHYLPHENOL* | .05 | .00 | 1.28 | 1.33 |
| 210 *PENTACHLOROPHENOL* | .23 | .10 | .17 | .50 |
| 301 *DICHLOROBENZENES* | .19 | .13 | 6.51 | 6.83 |
| 315 *NAPHTHALENE* | .08 | .05 | .88 | 1.00 |
| 326 *DIETHYL PHTHALATE* | 1.60 | .10 | .00 | 1.70 |
| 333 *DI-N-BUTYL PHTHALATE* | 1.21 | .20 | 1.16 | 2.57 |
| 337 *BUTYL BENZYL PHTHALATE* | .73 | .18 | 2.91 | 3.82 |
| 338 *BIS*(2-*ETHYLHEXYL*)*PHTHALATE* | .71 | .13 | .74 | 1.59 |
| 501 *ANTIMONY* | .29 | .01 | .03 | .32 |
| 502 *ARSENIC* | .98 | .04 | .06 | 1.08 |
| 504 *CADMIUM* | .05 | .01 | .36 | .42 |
| 505 *CHROMIUM* | 1.60 | .98 | 12.32 | 14.91 |
| 506 *COPPER* | 8.45 | .94 | 2.16 | 11.55 |
| 507 *LEAD* | 5.28 | .86 | 5.59 | 11.73 |
| 508 *MANGANESE* | 14.45 | 3.88 | 4.01 | 22.35 |
| 509 *MERCURY* | .03 | .01 | .03 | .07 |
| 510 *NICKEL* | .35 | .21 | 1.88 | 2.44 |
| 511 *SELENIUM* | .46 | .06 | .01 | .53 |
| 512 *SILVER* | .30 | .05 | 2.60 | 2.95 |
| 513 *THALLIUM* | .00 | .00 | .00 | .00 |
| 514 *ZINC* | 15.73 | 2.39 | 14.86 | 32.98 |
| 601 *TOTAL CYANIDES* | .18 | .00 | 1.57 | 1.75 |
| 602 *TOTAL PHENOLS* | 3.57 | .64 | 3.53 | 7.73 |
| 703 *AMMONIA* | 1.86 | .18 | .18 | 2.23 |
| 704 *OIL AND GREASE* | 6.20 | 1.88 | 1.83 | 9.91 |
| 705 *TSS* | 17.89 | 2.12 | 3.73 | 23.73 |
| 706 *TOC* | 9.16 | 1.83 | 2.25 | 13.24 |
| 707 *COD* | 31.21 | 5.98 | 9.34 | 46.53 |
| 708 *BOD* | 12.98 | 2.76 | 3.73 | 19.48 |

*Classicals in $10^3$ kg/day.

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## Table 26

## Relative Source Strength Comparison - Case A

| | Fraction | | | SUM* |
|---|---|---|---|---|
| | RES | COM | IND | Kg/day |
| 110 *1,1-DICHLOROETHYLENE* | .00 | 1.00 | .00 | .00 |
| 111 *1,1-DICHLOROETHANE* | .00 | 1.00 | .00 | .00 |
| 112 *TRANS-1,2-DICHLOROETHYLENE* | .00 | 1.00 | .00 | .01 |
| 113 *CHLOROFORM* | .87 | .13 | .00 | .45 |
| 114 *1,2-DICHLOROETHANE* | .69 | .31 | .00 | .00 |
| 115 *1,1,1-TRICHLOROETHANE* | .80 | .20 | .00 | .13 |
| 116 *CARBON TETRACHLORIDE* | .00 | 1.00 | .00 | .00 |
| 117 *BROMODICHLOROMETHANE* | .42 | .58 | .00 | .01 |
| 120 *TRICHLOROETHYLENE* | .47 | .53 | .00 | .21 |
| 121 *BENZENE* | .51 | .49 | .00 | .05 |
| 123 *DIBROMOCHLOROMETHANE* | .37 | .63 | .00 | .01 |
| 125 *BROMOFORM* | .00 | .00 | .00 | .00 |
| 127 *1,1,2,2-TETRACHLOROETHYLENE* | .82 | .18 | .00 | 1.03 |
| 128 *TOLUENE* | .80 | .20 | .00 | .48 |
| 129 *CHLOROBENZENE* | .96 | .04 | .00 | .01 |
| 130 *ETHYL BENZENE* | .67 | .33 | .00 | .08 |
| 203 *PHENOL* | .97 | .03 | .00 | 1.30 |
| 204 *2,4-DIMETHYLPHENOL* | 1.00 | .00 | .00 | .08 |
| 210 *PENTACHLOROPHENOL* | .87 | .13 | .00 | .38 |
| 301 *DICHLOROBENZENES* | .81 | .19 | .00 | .34 |
| 315 *NAPHTHALENE* | .84 | .16 | .00 | .14 |
| 326 *DIETHYL PHTHALATE* | .98 | .02 | .00 | 2.40 |
| 333 *DI-N-BUTYL PHTHALATE* | .95 | .05 | .00 | 1.87 |
| 337 *BUTYL BENZYL PHTHALATE* | .92 | .08 | .00 | 1.16 |
| 338 *BIS(2-ETHYLHEXYL)PHTHALATE* | .94 | .06 | .00 | 1.11 |
| 501 *ANTIMONY* | .99 | .01 | .00 | .42 |
| 502 *ARSENIC* | .98 | .02 | .00 | 1.45 |
| 504 *CADMIUM* | .94 | .06 | .00 | .08 |
| 505 *CHROMIUM* | .83 | .17 | .00 | 2.83 |
| 506 *COPPER* | .96 | .04 | .00 | 12.85 |
| 507 *LEAD* | .95 | .05 | .00 | 8.16 |
| 508 *MANGANESE* | .92 | .08 | .00 | 23.12 |
| 509 *MERCURY* | .94 | .06 | .00 | .05 |
| 510 *NICKEL* | .83 | .17 | .00 | .62 |
| 511 *SELENIUM* | .96 | .04 | .00 | .70 |
| 512 *SILVER* | .95 | .05 | .00 | .47 |
| 513 *THALLIUM* | .00 | 1.00 | .00 | .00 |
| 514 *ZINC* | .95 | .05 | .00 | 24.24 |
| 601 *TOTAL CYANIDES* | .99 | .01 | .00 | .27 |
| 602 *TOTAL PHENOLS* | .94 | .06 | .00 | 5.55 |
| 703 *AMMONIA* | .97 | .03 | .00 | 2.82 |
| 704 *OIL AND GREASE* | .91 | .09 | .00 | 10.02 |
| 705 *TSS* | .96 | .04 | .00 | 27.27 |
| 706 *TOC* | .94 | .06 | .00 | 14.33 |
| 707 *COD* | .94 | .06 | .00 | 48.72 |
| 708 *BOD* | .93 | .07 | .00 | 20.40 |

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*Classicals in $10^3$ kg/day.

## Table 27

### Relative Source Strength Comparison - Case B

| | Fraction | | | SUM |
|---|---|---|---|---|
| | RES | COM | IND | Kg/day* |
| 110 1,1-DICHLOROETHYLENE | .00 | .02 | .98 | .10 |
| 111 1,1-DICHLOROETHANE | .00 | .04 | .96 | .01 |
| 112 TRANS-1,2-DICHLOROETHYLENE | .00 | .12 | .88 | .11 |
| 113 CHLOROFORM | .69 | .11 | .20 | .52 |
| 114 1,2-DICHLOROETHANE | .27 | .14 | .59 | .01 |
| 115 1,1,1-TRICHLOROETHANE | .11 | .03 | .86 | .85 |
| 116 CARBON TETRACHLORIDE | .00 | .00 | 1.00 | .25 |
| 117 BROMODICHLOROMETHANE | .20 | .31 | .49 | .03 |
| 120 TRICHLOROETHYLENE | .21 | .27 | .52 | .42 |
| 121 BENZENE | .39 | .42 | .19 | .06 |
| 123 DIBROMOCHLOROMETHANE | .17 | .32 | .51 | .02 |
| 125 BROMOFORM | .00 | .00 | .00 | .00 |
| 127 1,1,2,2-TETRACHLOROETHYLENE | .49 | .12 | .39 | 1.56 |
| 128 TOLUENE | .39 | .11 | .50 | .90 |
| 129 CHLOROBENZENE | .49 | .02 | .49 | .02 |
| 130 ETHYL BENZENE | .05 | .03 | .92 | .94 |
| 203 PHENOL | .49 | .02 | .50 | 2.36 |
| 204 2,4-DIMETHYLPHENOL | .10 | .00 | .90 | .71 |
| 210 PENTACHLOROPHENOL | .69 | .11 | .20 | .44 |
| 301 DICHLOROBENZENES | .07 | .02 | .91 | 3.57 |
| 315 NAPHTHALENE | .19 | .04 | .77 | .57 |
| 326 DIETHYL PHTHALATE | .98 | .02 | .00 | 2.19 |
| 333 DI-N-BUTYL PHTHALATE | .70 | .04 | .25 | 2.29 |
| 337 BUTYL BENZYL PHTHALATE | .39 | .04 | .58 | 2.52 |
| 338 BIS(2-ETHYLHEXYL)PHTHALATE | .68 | .05 | .27 | 1.38 |
| 501 ANTIMONY | .96 | .01 | .04 | .40 |
| 502 ARSENIC | .96 | .02 | .02 | 1.35 |
| 504 CADMIUM | .27 | .02 | .71 | .25 |
| 505 CHROMIUM | .24 | .06 | .70 | 8.79 |
| 506 COPPER | .88 | .04 | .08 | 12.81 |
| 507 LEAD | .69 | .04 | .27 | 10.26 |
| 508 MANGANESE | .83 | .08 | .09 | 23.22 |
| 509 MERCURY | .70 | .05 | .25 | .07 |
| 510 NICKEL | .31 | .07 | .62 | 1.52 |
| 511 SELENIUM | .94 | .04 | .01 | .65 |
| 512 SILVER | .23 | .01 | .75 | 1.73 |
| 513 THALLIUM | .00 | .59 | .41 | .00 |
| 514 ZINC | .71 | .04 | .25 | 29.60 |
| 601 TOTAL CYANIDES | .24 | .00 | .76 | 1.03 |
| 602 TOTAL PHENOLS | .70 | .05 | .26 | 6.84 |
| 703 AMMONIA | .93 | .03 | .03 | 2.67 |
| 704 OIL AND GREASE | .82 | .09 | .09 | 10.12 |
| 705 TSS | .89 | .04 | .07 | 26.77 |
| 706 TOC | .86 | .06 | .08 | 14.25 |
| 707 COD | .84 | .06 | .09 | 49.27 |
| 708 BOD | .84 | .07 | .09 | 20.56 |

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*Classicals in $10^3$ kg/day.

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## Table 28

## Relative Source Strength Comparison - Case C

| | Fraction | | | SUM |
|---|---|---|---|---|
| | RES | COM | IND | Kg/day* |
| 110 1,1-DICHLOROETHYLENE | .00 | .02 | .98 | .30 |
| 111 1,1-DICHLOROETHANE | .00 | .03 | .97 | .04 |
| 112 TRANS-1,2-DICHLOROETHYLENE | .00 | .08 | .92 | .33 |
| 113 CHLOROFORM | .34 | .18 | .48 | .65 |
| 114 1,2-DICHLOROETHANE | .08 | .12 | .80 | .02 |
| 115 1,1,1-TRICHLOROETHANE | .03 | .02 | .95 | 2.32 |
| 116 CARBON TETRACHLORIDE | .00 | .00 | 1.00 | .74 |
| 117 BROMODICHLOROMETHANE | .06 | .28 | .67 | .06 |
| 120 TRICHLOROETHYLENE | .06 | .24 | .70 | .94 |
| 121 BENZENE | .15 | .50 | .35 | .09 |
| 123 DIBROMOCHLOROMETHANE | .05 | .28 | .67 | .04 |
| 125 BROMOFORM | .00 | .00 | .00 | .00 |
| 127 1,1,2,2-TETRACHLOROETHYLENE | .18 | .14 | .68 | 2.66 |
| 128 TOLUENE | .12 | .11 | .77 | 1.76 |
| 129 CHLOROBENZENE | .17 | .02 | .81 | .03 |
| 130 ETHYL BENZENE | .01 | .02 | .97 | 2.69 |
| 203 PHENOL | .17 | .02 | .82 | 4.31 |
| 204 2,4-DIMETHYLPHENOL | .02 | .00 | .98 | 1.96 |
| 210 PENTACHLOROPHENOL | .35 | .18 | .47 | .55 |
| 301 DICHLOROBENZENES | .02 | .01 | .97 | 10.05 |
| 315 NAPHTHALENE | .05 | .03 | .92 | 1.43 |
| 326 DIETHYL PHTHALATE | .93 | .07 | .00 | 1.44 |
| 333 DI-N-BUTYL PHTHALATE | .34 | .07 | .59 | 2.95 |
| 337 BUTYL BENZYL PHTHALATE | .12 | .04 | .85 | 5.15 |
| 338 BIS(2-ETHYLHEXYL)PHTHALATE | .32 | .07 | .61 | 1.84 |
| 501 ANTIMONY | .83 | .02 | .15 | .29 |
| 502 ARSENIC | .86 | .05 | .09 | .94 |
| 504 CADMIUM | .07 | .02 | .91 | .59 |
| 505 CHROMIUM | .06 | .05 | .89 | 20.80 |
| 506 COPPER | .63 | .08 | .29 | 11.23 |
| 507 LEAD | .32 | .06 | .61 | 13.66 |
| 508 MANGANESE | .55 | .18 | .27 | 21.97 |
| 509 MERCURY | .34 | .08 | .58 | .08 |
| 510 NICKEL | .09 | .06 | .85 | 3.33 |
| 511 SELENIUM | .83 | .12 | .05 | .46 |
| 512 SILVER | .06 | .01 | .93 | 4.20 |
| 513 THALLIUM | .00 | .49 | .51 | .00 |
| 514 ZINC | .35 | .06 | .59 | 37.81 |
| 601 TOTAL CYANIDES | .06 | .00 | .94 | 2.51 |
| 602 TOTAL PHENOLS | .33 | .07 | .59 | 8.91 |
| 703 AMMONIA | .77 | .09 | .14 | 2.02 |
| 704 OIL AND GREASE | .53 | .19 | .28 | 9.81 |
| 705 TSS | .66 | .09 | .25 | 22.65 |
| 706 TOC | .59 | .14 | .26 | 12.85 |
| 707 COD | .57 | .13 | .30 | 46.05 |
| 708 BOD | .56 | .14 | .29 | 19.21 |

*Classicals in $10^3$ kg/day.

## Table 29

## Relative Source Strength Comparison - Case D

| | Fraction | | | SUM Kg/day* |
|---|---|---|---|---|
| | RES | COM | IND | |
| 110 1,1-DICHLOROETHYLENE | .00 | .01 | .99 | .50 |
| 111 1,1-DICHLOROETHANE | .00 | .02 | .98 | .07 |
| 112 TRANS-1,2-DICHLOROETHYLENE | .00 | .05 | .95 | .53 |
| 113 CHLOROFORM | .17 | .15 | .67 | .77 |
| 114 1,2-DICHLOROETHANE | .03 | .08 | .89 | .03 |
| 115 1,1,1-TRICHLOROETHANE | .01 | .01 | .98 | 3.76 |
| 116 CARBON TETRACHLORIDE | .00 | .00 | 1.00 | 1.23 |
| 117 BROMODICHLOROMETHANE | .02 | .20 | .78 | .09 |
| 120 TRICHLOROETHYLENE | .02 | .16 | .81 | 1.35 |
| 121 BENZENE | .08 | .43 | .50 | .11 |
| 123 DIBROMOCHLOROMETHANE | .02 | .20 | .78 | .06 |
| 125 BROMOFORM | .00 | .00 | .00 | .00 |
| 127 1,1,2,2-TETRACHLOROETHYLENE | .08 | .10 | .82 | 3.68 |
| 128 TOLUENE | .05 | .07 | .88 | 2.58 |
| 129 CHLOROBENZENE | .07 | .02 | .92 | .04 |
| 130 ETHYL BENZENE | .00 | .01 | .98 | 4.41 |
| 203 PHENOL | .07 | .01 | .92 | 6.37 |
| 204 2,4-DIMETHYLPHENOL | .01 | .00 | .99 | 3.22 |
| 210 PENTACHLOROPHENOL | .18 | .15 | .67 | .65 |
| 301 DICHLOROBENZENES | .01 | .01 | .99 | 16.49 |
| 315 NAPHTHALENE | .02 | .02 | .96 | 2.28 |
| 326 DIETHYL PHTHALATE | .89 | .11 | .00 | .90 |
| 333 DI-N-BUTYL PHTHALATE | .16 | .05 | .78 | 3.70 |
| 337 BUTYL BENZYL PHTHALATE | .05 | .02 | .93 | 7.81 |
| 338 BIS(2-ETHYLHEXYL)PHTHALATE | .15 | .06 | .79 | 2.34 |
| 501 ANTIMONY | .64 | .02 | .33 | .22 |
| 502 ARSENIC | .73 | .07 | .21 | .67 |
| 504 CADMIUM | .03 | .01 | .96 | .93 |
| 505 CHROMIUM | .02 | .03 | .95 | 32.59 |
| 506 COPPER | .40 | .09 | .51 | 10.54 |
| 507 LEAD | .15 | .05 | .80 | 17.47 |
| 508 MANGANESE | .34 | .18 | .48 | 21.11 |
| 509 MERCURY | .16 | .06 | .77 | .10 |
| 510 NICKEL | .03 | .04 | .92 | 5.08 |
| 511 SELENIUM | .71 | .18 | .11 | .32 |
| 512 SILVER | .02 | .01 | .97 | 6.70 |
| 513 THALLIUM | .00 | .36 | .64 | .01 |
| 514 ZINC | .17 | .05 | .78 | 47.37 |
| 601 TOTAL CYANIDES | .02 | .00 | .98 | 4.01 |
| 602 TOTAL PHENOLS | .16 | .06 | .78 | 11.23 |
| 703 AMMONIA | .59 | .12 | .29 | 1.57 |
| 704 OIL AND GREASE | .32 | .20 | .48 | 9.56 |
| 705 TSS | .44 | .10 | .46 | 20.35 |
| 706 TOC | .38 | .15 | .47 | 12.02 |
| 707 COD | .35 | .13 | .52 | 44.87 |
| 708 BOD | .35 | .15 | .50 | 18.57 |

*Classicals in $10^3$ kg/day.

## Table 30

### Relative Source Strength Comparison - Case E

| Pollutant | Fraction |  |  | SUM |
|---|---|---|---|---|
|  | RES | COM | IND | Kg/day* |
| 110 1,1-*DICHLOROETHYLENE* | .00 | .02 | .98 | .20 |
| 111 1,1-*DICHLOROETHANE* | .00 | .04 | .96 | .03 |
| 112 *TRANS*-1,2-*DICHLOROETHYLENE* | .00 | .12 | .88 | .23 |
| 113 *CHLOROFORM* | .45 | .20 | .35 | .59 |
| 114 1,2-*DICHLOROETHANE* | .12 | .16 | .71 | .01 |
| 115 1,1,1-*TRICHLOROETHANE* | .04 | .03 | .92 | 1.59 |
| 116 *CARBON TETRACHLORIDE* | .00 | .00 | 1.00 | .49 |
| 117 *BROMODICHLOROMETHANE* | .09 | .35 | .56 | .05 |
| 120 *TRICHLOROETHYLENE* | .09 | .31 | .60 | .73 |
| 121 *BENZENE* | .19 | .55 | .26 | .08 |
| 123 *DIBROMOCHLOROMETHANE* | .07 | .36 | .57 | .04 |
| 125 *BROMOFORM* | .00 | .00 | .00 | .00 |
| 127 1,1,2,2-*TETRACHLOROETHYLENE* | .27 | .17 | .56 | 2.16 |
| 128 *TOLUENE* | .19 | .14 | .67 | 1.36 |
| 129 *CHLOROBENZENE* | .26 | .03 | .70 | .02 |
| 130 *ETHYL BENZENE* | .02 | .03 | .95 | 1.82 |
| 203 *PHENOL* | .26 | .02 | .72 | 3.28 |
| 204 2,4-*DIMETHYLPHENOL* | .04 | .00 | .96 | 1.33 |
| 210 *PENTACHLOROPHENOL* | .45 | .20 | .35 | .50 |
| 301 *DICHLOROBENZENES* | .03 | .02 | .95 | 6.83 |
| 315 *NAPHTHALENE* | .08 | .05 | .87 | 1.00 |
| 326 *DIETHYL PHTHALATE* | .94 | .06 | .00 | 1.70 |
| 333 *DI-N-BUTYL PHTHALATE* | .47 | .08 | .45 | 2.57 |
| 337 *BUTYL BENZYL PHTHALATE* | .19 | .05 | .76 | 3.82 |
| 338 *BIS(2-ETHYLHEXYL)PHTHALATE* | .45 | .08 | .47 | 1.59 |
| 501 *ANTIMONY* | .89 | .02 | .09 | .32 |
| 502 *ARSENIC* | .91 | .04 | .05 | 1.08 |
| 504 *CADMIUM* | .12 | .02 | .85 | .42 |
| 505 *CHROMIUM* | .11 | .07 | .83 | 14.91 |
| 506 *COPPER* | .73 | .08 | .19 | 11.55 |
| 507 *LEAD* | .45 | .07 | .48 | 11.73 |
| 508 *MANGANESE* | .65 | .17 | .18 | 22.35 |
| 509 *MERCURY* | .47 | .09 | .44 | .07 |
| 510 *NICKEL* | .14 | .09 | .77 | 2.44 |
| 511 *SELENIUM* | .86 | .11 | .03 | .53 |
| 512 *SILVER* | .10 | .02 | .88 | 2.95 |
| 513 *THALLIUM* | .00 | .59 | .41 | .00 |
| 514 *ZINC* | .48 | .07 | .45 | 32.98 |
| 601 *TOTAL CYANIDES* | .10 | .00 | .89 | 1.75 |
| 602 *TOTAL PHENOLS* | .46 | .08 | .46 | 7.73 |
| 703 *AMMONIA* | .83 | .08 | .08 | 2.23 |
| 704 *OIL AND GREASE* | .63 | .19 | .19 | 9.91 |
| 705 *TSS* | .75 | .09 | .16 | 23.73 |
| 706 *TOC* | .69 | .14 | .17 | 13.24 |
| 707 *COD* | .67 | .13 | .20 | 46.53 |
| 708 *BOD* | .67 | .14 | .19 | 19.48 |

*Classicals in $10^3$ kg/day.

## Table 31

### Total Mass Flow Comparison of Hypothetical Cities*

### (kg/day)**

| | | CASE A | CASE B | CASE C | CASE D | CASE E |
|---|---|---|---|---|---|---|
| 110 | *1,1-DICHLOROETHYLENE* | .00 | .10 | .30 | .50 | .20 |
| 111 | *1,1-DICHLOROETHANE* | .00 | .01 | .04 | .07 | .03 |
| 112 | *TRANS-1,2-DICHLOROETHYLENE* | .01 | .11 | .33 | .53 | .23 |
| 113 | *CHLOROFORM* | .45 | .52 | .65 | .77 | .59 |
| 114 | *1,2-DICHLOROETHANE* | .00 | .01 | .02 | .03 | .01 |
| 115 | *1,1,1-TRICHLOROETHANE* | .13 | .85 | 2.32 | 3.76 | 1.59 |
| 116 | *CARBON TETRACHLORIDE* | .00 | .25 | .74 | 1.23 | .49 |
| 117 | *BROMODICHLOROMETHANE* | .01 | .03 | .06 | .09 | .05 |
| 120 | *TRICHLOROETHYLENE* | .21 | .42 | .94 | 1.35 | .73 |
| 121 | *BENZENE* | .05 | .06 | .09 | .11 | .08 |
| 123 | *DIBROMOCHLOROMETHANE* | .01 | .02 | .04 | .06 | .04 |
| 125 | *BROMOFORM* | .00 | .00 | .00 | .00 | .00 |
| 127 | *1,1,2,2-TETRACHLOROETHYLENE* | 1.03 | 1.56 | 2.66 | 3.68 | 2.16 |
| 128 | *TOLUENE* | .48 | .90 | 1.76 | 2.58 | 1.30 |
| 129 | *CHLOROBENZENE* | .01 | .02 | .03 | .04 | .02 |
| 130 | *ETHYL BENZENE* | .08 | .94 | 2.69 | 4.41 | 1.6[illegible] |
| 203 | *PHENOL* | 1.30 | 2.36 | 4.31 | 6.37 | 3.28 |
| 204 | *2,4-DIMETHYLPHENOL* | .08 | .71 | 1.96 | 3.22 | 1.33 |
| 210 | *PENTACHLOROPHENOL* | .38 | .44 | .55 | .65 | .50 |
| 301 | *DICHLOROBENZENES* | .34 | 3.57 | 10.05 | 16.49 | 6.53 |
| 315 | *NAPHTHALENE* | .14 | .57 | 1.43 | 2.28 | 1.00 |
| 326 | *DIETHYL PHTHALATE* | 2.40 | 2.19 | 1.44 | .90 | 1.70 |
| 333 | *DI-N-BUTYL PHTHALATE* | 1.87 | 2.29 | 2.95 | 3.70 | 2.57 |
| 337 | *BUTYL BENZYL PHTHALATE* | 1.16 | 2.52 | 5.15 | 7.81 | 3.82 |
| 338 | *BIS(2-ETHYLHEXYL)PHTHALATE* | 1.11 | 1.38 | 1.84 | 2.34 | 1.59 |
| 501 | *ANTIMONY* | .42 | .40 | .29 | .22 | .32 |
| 502 | *ARSENIC* | 1.45 | 1.35 | .94 | .67 | 1.18 |
| 504 | *CADMIUM* | .08 | .25 | .59 | .93 | .42 |
| 505 | *CHROMIUM* | 2.83 | 8.79 | 20.80 | 32.59 | 14.91 |
| 506 | *COPPER* | 12.85 | 12.81 | 11.23 | 10.54 | 11.55 |
| 507 | *LEAD* | 8.16 | 10.26 | 13.66 | 17.47 | 11.73 |
| 508 | *MANGANESE* | 23.12 | 23.22 | 21.97 | 21.11 | 22.35 |
| 509 | *MERCURY* | .05 | .07 | .08 | .10 | .07 |
| 510 | *NICKEL* | .62 | 1.52 | 3.33 | 5.08 | 2.44 |
| 511 | *SELENIUM* | .70 | .65 | .46 | .32 | .53 |
| 512 | *SILVER* | .47 | 1.73 | 4.20 | 6.70 | 2.95 |
| 513 | *THALLIUM* | .00 | .00 | .00 | .01 | .00 |
| 514 | *ZINC* | 24.24 | 29.60 | 37.81 | 47.37 | 32.93 |
| 601 | *TOTAL CYANIDES* | .27 | 1.03 | 2.51 | 4.01 | 1.75 |
| 602 | *TOTAL PHENOLS* | 5.55 | 6.84 | 8.91 | 11.23 | 7.73 |
| 703 | *AMMONIA* | 2.82 | 2.67 | 2.02 | 1.57 | 2.23 |
| 704 | *OIL AND GREASE* | 10.02 | 10.12 | 9.81 | 9.56 | 9.91 |
| 705 | *TSS* | 27.27 | 26.77 | 22.65 | 20.35 | 23.73 |
| 706 | *TOC* | 14.33 | 14.25 | 12.85 | 12.02 | 13.24 |
| 707 | *COD* | 48.72 | 49.27 | 46.05 | 44.87 | 46.53 |
| 708 | *BOD* | 20.40 | 20.56 | 19.21 | 18.57 | 19.48 |

*A flow of 0.08 kg/day would be equivalent to a concentration of 1 μg/L.

**Classicals in $10^3$ kg/day.

## Table 32

## Relative Comparison of Hypothetical City Loadings*

| | CASE A | CASE B | CASE C | CASE D | CASE E |
|---|---|---|---|---|---|
| 110 1,1-*DICHLOROETHYLENE* | .00 | .20 | .60 | 1.00 | .41 |
| 111 1,1-*DICHLOROETHANE* | .01 | .21 | .61 | 1.00 | .41 |
| 112 *TRANS*-1,2-*DICHLOROETHYLENE* | .03 | .22 | .62 | 1.00 | .43 |
| 113 *CHLOROFORM* | .59 | .68 | .85 | 1.00 | .77 |
| 114 1,2-*DICHLOROETHANE* | .13 | .30 | .67 | 1.00 | .50 |
| 115 1,1,1-*TRICHLOROETHANE* | .03 | .23 | .62 | 1.00 | .42 |
| 116 *CARBON TETRACHLORIDE* | .00 | .20 | .60 | 1.00 | .40 |
| 117 *BROMODICHLOROMETHANE* | .17 | .32 | .70 | 1.00 | .56 |
| 120 *TRICHLOROETHYLENE* | .15 | .31 | .69 | 1.00 | .54 |
| 121 *BENZENE* | .44 | .52 | .85 | 1.00 | .78 |
| 123 *DIBROMOCHLOROMETHANE* | .16 | .31 | .70 | 1.00 | .55 |
| 125 *BROMOFORM* | 0 | 0 | 0 | 0 | 0 |
| 127 1,1,2,2-*TETRACHLOROETHYLENE* | .28 | .42 | .72 | 1.00 | .59 |
| 128 *TOLUENE* | .19 | .35 | .68 | 1.00 | .53 |
| 129 *CHLOROBENZENE* | .21 | .37 | .68 | 1.00 | .52 |
| 130 *ETHYL BENZENE* | .02 | .21 | .61 | 1.00 | .41 |
| 203 *PHENOL* | .20 | .37 | .68 | 1.00 | .52 |
| 204 2,4-*DIMETHYLPHENOL* | .02 | .22 | .61 | 1.00 | .41 |
| 210 *PENTACHLOROPHENOL* | .59 | .68 | .85 | 1.00 | .77 |
| 301 *DICHLOROBENZENES* | .02 | .22 | .61 | 1.00 | .41 |
| 315 *NAPHTHALENE* | .06 | .25 | .63 | 1.00 | .44 |
| 326 *DIETHYL PHTHALATE* | 1.00 | .91 | .60 | .37 | .71 |
| 333 *DI-N-BUTYL PHTHALATE* | .51 | .62 | .80 | 1.00 | .69 |
| 337 *BUTYL BENZYL PHTHALATE* | .15 | .32 | .66 | 1.00 | .49 |
| 338 *BIS*(2-*ETHYLHEXYL*)*PHTHALATE* | .47 | .59 | .79 | 1.00 | .68 |
| 501 *ANTIMONY* | 1.00 | .95 | .68 | .52 | .76 |
| 502 *ARSENIC* | 1.00 | .93 | .65 | .46 | .74 |
| 504 *CADMIUM* | .09 | .27 | .63 | 1.00 | .45 |
| 505 *CHROMIUM* | .09 | .27 | .64 | 1.00 | .46 |
| 506 *COPPER* | 1.00 | 1.00 | .87 | .82 | .90 |
| 507 *LEAD* | .47 | .59 | .78 | 1.00 | .67 |
| 508 *MANGANESE* | 1.00 | 1.00 | .95 | .91 | .96 |
| 509 *MERCURY* | .52 | .63 | .80 | 1.00 | .70 |
| 510 *NICKEL* | .12 | .30 | .65 | 1.00 | .48 |
| 511 *SELENIUM* | 1.00 | .92 | .66 | .46 | .76 |
| 512 *SILVER* | .07 | .26 | .63 | 1.00 | .44 |
| 513 *THALLIUM* | .18 | .31 | .75 | 1.00 | .62 |
| 514 *ZINC* | .51 | .62 | .80 | 1.00 | .70 |
| 601 *TOTAL CYANIDES* | .07 | .26 | .62 | 1.00 | .44 |
| 602 *TOTAL PHENOLS* | .49 | .61 | .79 | 1.00 | .69 |
| 703 *AMMONIA* | 1.00 | .95 | .71 | .56 | .79 |
| 704 *OIL AND GREASE* | .99 | 1.00 | .97 | .94 | .98 |
| 705 *TSS* | 1.00 | .98 | .83 | .75 | .87 |
| 706 *TOC* | 1.00 | .99 | .90 | .84 | .92 |
| 707 *COD* | .99 | 1.00 | .93 | .91 | .94 |
| 708 *BOD* | .99 | 1.00 | .93 | .90 | .95 |

*Ratio of source SUMs to largest SUM.

## 2. Application to Cities Actually Sampled

In the detailed reports on the individual cities, attempts were made to conduct a mass balance analysis comparing sources and POTW influent. These comparisons were limited, however, due to having sampled only a relatively small fraction of a given source type from which to project or, as in the Hartford case, not having any industrial sites to represent the industrial component. One other means of carrying out the mass balance analysis is to use the average index values developed in this report to scale the basins sampled. This approach also provides an opportunity to compare the values projected from these source indices to actual influent values and thus serve as a test of the validity of the indices and the value in general of this type of approach.

Table 33 gives a summary of the basic characteristics of each of the cities which have been studied. These population and flow values have been used to scale the index values presented in part A of this section to give the mass contribution from each source type. From these values, an influent SUM was calculated and compared to the values actually observed at the POTW influent (INF). It must be borne in mind that these analyses are done using an "averaged" industrial value and are limited by the fact that the industrial contribution is a major component of the total and is industry specific.

The mass balance data for the cities using this approach involving the average data base values are given in Tables 34-37. The SUM/INF values for each have been summarized in Table 38 for convenience in analyzing the degree of "balance." SUM/INF values have been included only for those cases where the INF mass flow rate was at least 0.01 Kg/day. This value corresponds to an influent concentration of 0.1-0.35 μg/L, dependent on the city (see Table 33). Further, those SUM/INF values whose average influent concentrations were less than 1 μg/L, indicated by ( ), were excluded from interpretation because their values were too small to be reliable for the mass balance analysis. It is seen that some pollutants have higher source (SUM) levels than the influent (INF), while others are lower and some are about the same. Because of the uncertainties in each of the concentration and flow values used

Table 33

Summary of Discharge Characteristics for Cities Studied

| City | POTW Influent Flow (Lps) | Mass Flow for 1 µg/L Influent Concentration | Population and Flow | | | |
|---|---|---|---|---|---|---|
| | | | RES | | COM | IND |
| | | | Population | Flow (Lps) | Lps | Lps |
| Cincinnati | 427 | 0.04 | 87,900 | 385 | 32 | 4.3 |
| St. Louis | 1,022 | 0.08 | 200,000 | 876 | 100 | 122 |
| Atlanta | 4,072 | 0.35 | 385,000 | 1,687 | 847 | 729 |
| Hartford | 2,444 | 0.21 | 285,000 | 1,248 | 538 | 171 |

## Table 34

### Cincinnati Mass Balance Using Four City Averages

| Pollutant | Kg/day* | | | | | SUM/INF** |
|---|---|---|---|---|---|---|
| | RES | COM | IND | SUM | INF | |
| 110 1,1-DICHLOROETHYLENE | .00 | .00 | .00 | .01 | .00 | |
| 111 1,1-DICHLOROETHANE | .00 | .00 | .00 | .00 | .00 | |
| 112 TRANS-1,2-DICHLOROETHYLENE | .00 | .00 | .00 | .01 | .00 | |
| 113 CHLOROFORM | .17 | .02 | .00 | .20 | .10 | 2.01 |
| 114 1,2-DICHLOROETHANE | .00 | .00 | .00 | .00 | .02 | (.10) |
| 115 1,1,1-TRICHLOROETHANE | .05 | .01 | .03 | .08 | .01 | (7.60) |
| 116 CARBON TETRACHLORIDE | .00 | .00 | .01 | .01 | .00 | |
| 117 BROMODICHLOROMETHANE | .00 | .00 | .00 | .01 | .00 | |
| 120 TRICHLOROETHYLENE | .04 | .04 | .01 | .09 | .00 | |
| 121 BENZENE | .01 | .01 | .00 | .02 | .14 | .14 |
| 123 DIBROMOCHLOROMETHANE | .00 | .00 | .00 | .00 | .00 | |
| 125 BROMOFORM | .00 | .00 | .00 | .00 | .00 | |
| 127 1,1,2,2-TETRACHLOROETHYLENE | .37 | .06 | .03 | .46 | .04 | 10.86 |
| 128 TOLUENE | .17 | .03 | .02 | .22 | .07 | 3.07 |
| 129 CHLOROBENZENE | .00 | .00 | .00 | .00 | .00 | |
| 130 ETHYL BENZENE | .02 | .01 | .04 | .07 | .03 | (2.15) |
| 203 PHENOL | .55 | .01 | .05 | .61 | .00 | |
| 204 2,4-DIMETHYLPHENOL | .03 | .00 | .03 | .06 | .00 | |
| 210 PENTACHLOROPHENOL | .15 | .02 | .00 | .17 | .14 | 1.19 |
| 301 DICHLOROBENZENES | .12 | .02 | .14 | .28 | .00 | |
| 315 NAPHTHALENE | .05 | .01 | .02 | .08 | .14 | .56 |
| 326 DIETHYL PHTHALATE | 1.03 | .02 | .00 | 1.05 | .43 | 2.45 |
| 333 DI-N-BUTYL PHTHALATE | .78 | .03 | .02 | .84 | .46 | 1.80 |
| 337 BUTYL BENZYL PHTHALATE | .47 | .03 | .06 | .56 | .00 | |
| 338 BIS(2-ETHYLHEXYL)PHTHALATE | .46 | .02 | .02 | .49 | .15 | 3.00 |
| 501 ANTIMONY | .19 | .00 | .00 | .19 | .00 | |
| 502 ARSENIC | .63 | .01 | .00 | .64 | .80 | .80 |
| 504 CADMIUM | .03 | .00 | .01 | .04 | .09 | .48 |
| 505 CHROMIUM | 1.03 | .16 | .26 | 1.45 | 5.58 | .26 |
| 506 COPPER | 5.44 | .15 | .05 | 5.64 | 2.29 | 2.46 |
| 507 LEAD | 3.40 | .14 | .12 | 3.65 | .59 | 6.24 |
| 508 MANGANESE | 9.30 | .62 | .09 | 10.01 | 12.62 | .79 |
| 509 MERCURY | .02 | .00 | .00 | .02 | .02 | (1.56) |
| 510 NICKEL | .23 | .03 | .04 | .30 | 1.28 | .24 |
| 511 SELENIUM | .30 | .01 | .00 | .31 | .20 | 1.56 |
| 512 SILVER | .20 | .01 | .06 | .26 | .14 | 1.92 |
| 513 THALLIUM | .00 | .00 | .00 | .00 | .00 | |
| 514 ZINC | 10.13 | .38 | .32 | 10.83 | 13.71 | .79 |
| 601 TOTAL CYANIDES | .12 | .00 | .03 | .15 | 1.46 | .10 |
| 602 TOTAL PHENOLS | 2.30 | .10 | .08 | 2.48 | .91 | 2.71 |
| 703 AMMONIA | 1.20 | .03 | .00 | 1.23 | .51 | 2.41 |
| 704 OIL AND GREASE | 3.99 | .30 | .04 | 4.33 | 1.80 | 2.41 |
| 705 TSS | 11.52 | .34 | .08 | 11.93 | 3.87 | 3.09 |
| 706 TOC | 5.89 | .29 | .05 | 6.24 | 1.58 | 3.94 |
| 707 COD | 20.09 | .96 | .20 | 21.25 | 5.82 | 3.65 |
| 708 BOD | 8.36 | .44 | .08 | 8.88 | 1.75 | 5.06 |

* Classicals in units of $10^3$ kg/day.

**Calculated for pollutants with INF >0.01 kg/day; values in () for INF less than 0.04 kg/day.

## Table 35

## St. Louis Mass Balance Using Four City Averages

| Pollutant | Kg/day* | | | | | SUM/INF** |
|---|---|---|---|---|---|---|
| | RES | COM | IND | SUM | INF | |
| 110 1,1-DICHLOROETHYLENE | .00 | .00 | .12 | .12 | .08 | 1.62 |
| 111 1,1-DICHLOROETHANE | .00 | .00 | .02 | .02 | .03 | ( .56) |
| 112 TRANS-1,2-DICHLOROETHYLENE | .00 | .01 | .12 | .14 | .04 | (3.06) |
| 113 CHLOROFORM | .39 | .06 | .13 | .58 | .54 | 1.06 |
| 114 1,2-DICHLOROETHANE | .00 | .00 | .01 | .01 | .00 | |
| 115 1,1,1-TRICHLOROETHANE | .10 | .03 | .90 | 1.03 | .82 | 1.25 |
| 116 CARBON TETRACHLORIDE | .00 | .00 | .30 | .30 | .00 | |
| 117 BROMODICHLOROMETHANE | .01 | .01 | .02 | .03 | .06 | ( .54) |
| 120 TRICHLOROETHYLENE | .10 | .11 | .27 | .48 | 2.52 | .19 |
| 121 BENZENE | .02 | .02 | .01 | .06 | .62 | .10 |
| 123 DIBROMOCHLOROMETHANE | .00 | .01 | .01 | .02 | .09 | .25 |
| 125 BROMOFORM | .00 | .00 | .00 | .00 | .00 | |
| 127 1,1,2,2-TETRACHLOROETHYLENE | .85 | .18 | .74 | 1.77 | 3.97 | .45 |
| 128 TOLUENE | .39 | .09 | .55 | 1.03 | 5.32 | .19 |
| 129 CHLOROBENZENE | .01 | .00 | .01 | .02 | .01 | (1.31) |
| 130 ETHYL BENZENE | .05 | .03 | 1.06 | 1.14 | 1.38 | .82 |
| 203 PHENOL | 1.26 | .04 | 1.43 | 2.73 | .93 | 2.93 |
| 204 2,4-DIMETHYLPHENOL | .08 | .00 | .78 | .85 | .00 | |
| 210 PENTACHLOROPHENOL | .33 | .05 | .11 | .49 | .00 | |
| 301 DICHLOROBENZENES | .28 | .07 | 3.97 | 4.31 | 2.30 | 1.87 |
| 315 NAPHTHALENE | .12 | .02 | .53 | .68 | .87 | .77 |
| 326 DIETHYL PHTHALATE | 2.35 | .05 | .00 | 2.40 | .62 | 3.90 |
| 333 DI-N-BUTYL PHTHALATE | 1.77 | .10 | .71 | 2.58 | 1.40 | 1.85 |
| 337 BUTYL BENZYL PHTHALATE | 1.07 | .09 | 1.77 | 2.93 | 1.00 | 2.93 |
| 338 BIS(2-ETHYLHEXYL)PHTHALATE | 1.04 | .07 | .45 | 1.56 | .38 | 4.12 |
| 501 ANTIMONY | .42 | .00 | .02 | .44 | 4.66 | .09 |
| 502 ARSENIC | 1.43 | .02 | .03 | 1.49 | .00 | |
| 504 CADMIUM | .08 | .00 | .22 | .30 | .26 | 1.15 |
| 505 CHROMIUM | 2.34 | .49 | 7.52 | 10.35 | 11.95 | .87 |
| 506 COPPER | 12.38 | .47 | 1.32 | 14.16 | 4.11 | 3.45 |
| 507 LEAD | 7.73 | .43 | 3.41 | 11.57 | 18.58 | .62 |
| 508 MANGANESE | 21.17 | 1.94 | 2.45 | 25.56 | 17.79 | 1.44 |
| 509 MERCURY | .05 | .00 | .02 | .07 | .04 | (1.66) |
| 510 NICKEL | .52 | .11 | 1.15 | 1.77 | 4.05 | .44 |
| 511 SELENIUM | .68 | .03 | .01 | .71 | .38 | 1.86 |
| 512 SILVER | .45 | .03 | 1.59 | 2.06 | 1.41 | 1.45 |
| 513 THALLIUM | .00 | .00 | .00 | .00 | .00 | |
| 514 ZINC | 23.05 | 1.19 | 9.07 | 33.31 | 25.64 | 1.30 |
| 601 TOTAL CYANIDES | .27 | .00 | .96 | 1.22 | 1.29 | .95 |
| 602 TOTAL PHENOLS | 5.23 | .32 | 2.15 | 7.70 | 5.37 | 1.43 |
| 703 AMMONIA | 2.73 | .09 | .11 | 2.93 | 1.50 | 1.96 |
| 704 OIL AND GREASE | 9.08 | .94 | 1.12 | 11.14 | 2.74 | 4.07 |
| 705 TSS | 26.21 | 1.06 | 2.27 | 29.54 | 11.02 | 2.68 |
| 706 TOC | 13.41 | .92 | 1.37 | 15.70 | 8.58 | 1.83 |
| 707 COD | 45.73 | 2.99 | 5.70 | 54.42 | 26.98 | 2.02 |
| 708 BOD | 19.02 | 1.38 | 2.28 | 22.68 | 13.66 | 1.66 |

* Classicals in units of $10^3$ kg/day.

**Calculated for pollutants with INF >0.01 kg/day; values in () for INF less than 0.08 kg/day.

## Table 36

## Atlanta Mass Balance Using Four City Averages

| Pollutant | RES | COM | IND | SUM | INF | SUM/INF** |
|---|---|---|---|---|---|---|
| | Kg/day* | | | | | |
| 110 1,1-DICHLOROETHYLENE | .00 | .02 | .73 | .75 | 3.02 | .25 |
| 111 1,1-DICHLOROETHANE | .00 | .01 | .10 | .10 | .00 | |
| 112 TRANS-1,2-DICHLOROETHYLENE | .00 | .11 | .74 | .85 | 6.54 | .13 |
| 113 CHLOROFORM | .76 | .49 | .75 | 2.01 | 2.51 | .80 |
| 114 1,2-DICHLOROETHANE | .00 | .01 | .04 | .05 | .14 | (.37) |
| 115 1,1,1-TRICHLOROETHANE | .20 | .21 | 5.36 | 5.78 | 33.75 | .17 |
| 116 CARBON TETRACHLORIDE | .00 | .01 | 1.79 | 1.80 | .00 | |
| 117 BROMODICHLOROMETHANE | .01 | .07 | .10 | .18 | .00 | |
| 120 TRICHLOROETHYLENE | .19 | .94 | 1.60 | 2.73 | 58.02 | .05 |
| 121 BENZENE | .05 | .20 | .08 | .32 | .00 | |
| 123 DIBROMOCHLOROMETHANE | .01 | .05 | .07 | .13 | .00 | |
| 125 BROMOFORM | .00 | .00 | .00 | .00 | .00 | |
| 127 1,1,2,2-TETRACHLOROETHYLENE | 1.63 | 1.57 | 4.40 | 7.60 | 84.21 | .09 |
| 128 TOLUENE | .74 | .80 | 3.29 | 4.84 | 8.97 | .54 |
| 129 CHLOROBENZENE | .02 | .00 | .06 | .08 | .00 | |
| 130 ETHYL BENZENE | .10 | .22 | 6.33 | 6.65 | 17.15 | .39 |
| 203 PHENOL | 2.42 | .33 | 8.56 | 11.31 | 6.63 | 1.71 |
| 204 2,4-DIMETHYLPHENOL | .14 | .00 | 4.66 | 4.80 | 3.48 | 1.38 |
| 210 PENTACHLOROPHENOL | .65 | .42 | .63 | 1.70 | 6.75 | .25 |
| 301 DICHLOROBENZENES | .54 | .55 | 23.72 | 24.80 | 32.62 | .76 |
| 315 NAPHTHALENE | .23 | .19 | 3.20 | 3.62 | 11.56 | .31 |
| 326 DIETHYL PHTHALATE | 4.53 | .42 | .00 | 4.95 | 1.76 | 2.82 |
| 333 DI-N-BUTYL PHTHALATE | 3.41 | .86 | 4.23 | 8.50 | 1.55 | 5.50 |
| 337 BUTYL BENZYL PHTHALATE | 2.06 | .77 | 10.60 | 13.43 | 27.18 | .49 |
| 339 BIS(2-ETHYLHEXYL)PHTHALATE | 2.00 | .56 | 2.71 | 5.27 | .00 | |
| 501 ANTIMONY | .81 | .02 | .11 | .94 | .22 | (4.36) |
| 502 ARSENIC | 2.76 | .19 | .20 | 3.15 | .00 | |
| 504 CADMIUM | .15 | .04 | 1.31 | 1.50 | 1.10 | 1.36 |
| 505 CHROMIUM | 4.52 | 4.16 | 44.92 | 53.60 | 25.37 | 2.11 |
| 506 COPPER | 23.85 | 3.99 | 7.86 | 35.70 | 17.71 | 2.02 |
| 507 LEAD | 14.90 | 3.64 | 20.39 | 38.93 | 47.72 | .82 |
| 508 MANGANESE | 40.80 | 16.45 | 14.62 | 71.87 | 97.63 | .74 |
| 509 MERCURY | .10 | .03 | .12 | .24 | .28 | (.86) |
| 510 NICKEL | 1.00 | .91 | 6.84 | 8.75 | 6.45 | 1.36 |
| 511 SELENIUM | 1.30 | .24 | .05 | 1.60 | .00 | |
| 512 SILVER | .86 | .21 | 9.49 | 10.55 | 4.37 | 2.41 |
| 513 THALLIUM | .00 | .01 | .00 | .01 | .00 | |
| 514 ZINC | 44.42 | 10.10 | 54.17 | 108.69 | 124.26 | .87 |
| 601 TOTAL CYANIDES | .51 | .02 | 5.71 | 6.24 | 1.73 | 3.62 |
| 602 TOTAL PHENOLS | 10.08 | 2.70 | 12.85 | 25.64 | 35.13 | .73 |
| 703 AMMONIA | 5.26 | .78 | .67 | 6.71 | 2.61 | 2.57 |
| 704 OIL AND GREASE | 17.50 | 7.98 | 6.69 | 32.16 | 10.04 | 3.20 |
| 705 TSS | 50.51 | 8.96 | 13.59 | 73.06 | 48.51 | 1.51 |
| 706 TOC | 25.85 | 7.77 | 8.20 | 41.82 | 23.88 | 1.75 |
| 707 COD | 88.13 | 25.32 | 34.03 | 147.48 | 65.03 | 2.27 |
| 708 BOD | 36.65 | 11.71 | 13.61 | 61.97 | 35.49 | 1.75 |

* Classicals in units of $10^3$ kg/day.

**Calculated for pollutants with INF >0.01 kg/day; values in () for INF less than 0.35 kg/day.

## Table 37

## Hartford Mass Balance Using Four City Averages

| Pollutant | Kg/day* RES | COM | IND | SUM | INF | SUM/INF** |
|---|---|---|---|---|---|---|
| 110 1,1-*DICHLOROETHYLENE* | .00 | .01 | .17 | .18 | .00 | |
| 111 1,1-*DICHLOROETHANE* | .00 | .00 | .02 | .03 | .00 | |
| 112 *TRANS*-1,2-*DICHLOROETHYLENE* | .00 | .07 | .17 | .24 | .00 | |
| 113 *CHLOROFORM* | .56 | .31 | .18 | 1.05 | .77 | 1.36 |
| 114 1,2-*DICHLOROETHANE* | .00 | .01 | .01 | .02 | .00 | |
| 115 1,1,1-*TRICHLOROETHANE* | .15 | .14 | 1.26 | 1.54 | 2.16 | .71 |
| 116 *CARBON TETRACHLORIDE* | .00 | .00 | .42 | .42 | .00 | |
| 117 *BROMODICHLOROMETHANE* | .01 | .05 | .02 | .08 | .00 | |
| 120 *TRICHLOROETHYLENE* | .14 | .60 | .38 | 1.11 | 1.78 | .62 |
| 121 *BENZENE* | .03 | .12 | .02 | .18 | .00 | |
| 123 *DIBROMOCHLOROMETHANE* | .01 | .03 | .02 | .06 | .00 | |
| 125 *BROMOFORM* | .00 | .00 | .00 | .00 | .00 | |
| 127 1,1,2,2-*TETRACHLOROETHYLENE* | 1.21 | 1.00 | 1.03 | 3.23 | 5.54 | .58 |
| 128 *TOLUENE* | .55 | .51 | .77 | 1.83 | 3.29 | .56 |
| 129 *CHLOROBENZENE* | .01 | .00 | .01 | .03 | .00 | |
| 130 *ETHYL BENZENE* | .08 | .14 | 1.48 | 1.70 | .00 | |
| 203 *PHENOL* | 1.79 | .21 | 2.01 | 4.01 | .00 | |
| 204 2,4-*DIMETHYLPHENOL* | .11 | .00 | 1.09 | 1.20 | .00 | |
| 210 *PENTACHLOROPHENOL* | .48 | .27 | .15 | .89 | .00 | |
| 301 *DICHLOROBENZENES* | .40 | .35 | 5.56 | 6.31 | 2.83 | 2.23 |
| 315 *NAPHTHALENE* | .17 | .12 | .75 | 1.04 | .00 | |
| 326 *DIETHYL PHTHALATE* | 3.35 | .27 | .00 | 3.62 | .77 | 4.72 |
| 333 *DI-N-BUTYL PHTHALATE* | 2.53 | .55 | .99 | 4.06 | .89 | 4.56 |
| 337 *BUTYL BENZYL PHTHALATE* | 1.52 | .49 | 2.49 | 4.50 | .00 | |
| 338 *BIS(2-ETHYLHEXYL)PHTHALATE* | 1.48 | .36 | .63 | 2.47 | .00 | |
| 501 *ANTIMONY* | .60 | .01 | .03 | .64 | .00 | |
| 502 *ARSENIC* | 2.04 | .12 | .05 | 2.21 | .41 | 5.38 |
| 504 *CADMIUM* | .11 | .03 | .31 | .44 | .00 | |
| 505 *CHROMIUM* | 3.34 | 2.64 | 10.54 | 16.52 | 13.81 | 1.20 |
| 506 *COPPER* | 17.64 | 2.53 | 1.84 | 22.01 | 20.40 | 1.08 |
| 507 *LEAD* | 11.01 | 2.31 | 4.78 | 18.11 | 7.51 | 2.41 |
| 508 *MANGANESE* | 30.17 | 10.45 | 3.43 | 44.05 | 33.37 | 1.32 |
| 509 *MERCURY* | .07 | .02 | .03 | .12 | .00 | |
| 510 *NICKEL* | .74 | .58 | 1.61 | 2.92 | 7.39 | .40 |
| 511 *SELENIUM* | .96 | .15 | .01 | 1.13 | .00 | |
| 512 *SILVER* | .64 | .13 | 2.22 | 2.99 | .69 | 4.34 |
| 513 *THALLIUM* | .00 | .01 | .00 | .01 | .00 | |
| 514 *ZINC* | 32.84 | 6.42 | 12.71 | 51.97 | 33.23 | 1.56 |
| 601 *TOTAL CYANIDES* | .38 | .01 | 1.34 | 1.73 | .84 | 2.07 |
| 602 *TOTAL PHENOLS* | 7.45 | 1.72 | 3.01 | 12.19 | 11.08 | 1.10 |
| 703 *AMMONIA* | 3.89 | .50 | .16 | 4.54 | 1.99 | 2.28 |
| 704 *OIL AND GREASE* | 12.94 | 5.07 | 1.57 | 19.57 | 7.85 | 2.49 |
| 705 *TSS* | 37.35 | 5.69 | 3.19 | 46.23 | 16.23 | 2.85 |
| 706 *TOC* | 19.12 | 4.93 | 1.92 | 25.97 | 8.98 | 2.89 |
| 707 *COD* | 65.17 | 16.08 | 7.98 | 89.23 | 40.34 | 2.21 |
| 708 *BOD* | 27.10 | 7.44 | 3.19 | 37.73 | 14.37 | 2.62 |

* Classicals in units of $10^3$ kg/day.

**Calculated for pollutants with INF >0.01 kg/day; values in () for INF less than 0.21 kg/day.

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## Table 38

### Mass Balance Analysis For All Four Cities

| | SUM/INF | | | |
|---|---|---|---|---|
| | Cincinnati | St. Louis | Atlanta | Hartford |
| 110 1,1-DICHLOROETHYLENE | | 1.62 | .25 | |
| 111 1,1-DICHLOROETHANE | | (.56) | | |
| 112 TRANS-1,2-DICHLOROETHYLENE | | (3.06) | .13 | |
| 113 CHLOROFORM | 2.01 | 1.06 | .80 | 1.36 |
| 114 1,2-DICHLOROETHANE | (.10) | | (.37) | |
| 115 1,1,1-TRICHLOROETHANE | (7.80) | 1.25 | .17 | .71 |
| 116 CARBON TETRACHLORIDE | | | | |
| 117 BROMODICHLOROMETHANE | | (.54) | | |
| 120 TRICHLOROETHYLENE | | .19 | .05 | .62 |
| 121 BENZENE | .14 | .10 | | |
| 123 DIBROMOCHLOROMETHANE | | .25 | | |
| 125 BROMOFORM | | | | |
| 127 1,1,2,2-TETRACHLOROETHYLENE | 10.86 | .45 | .09 | .58 |
| 128 TOLUENE | 3.07 | .15 | .54 | .56 |
| 129 CHLOROBENZENE | | (1.31) | | |
| 130 ETHYL BENZENE | (2.15) | .82 | .39 | |
| 203 PHENOL | | 2.93 | 1.71 | |
| 204 2,4-DIMETHYLPHENOL | | | 1.36 | |
| 210 PENTACHLOROPHENOL | 1.19 | | .25 | |
| 301 DICHLOROBENZENES | | 1.87 | .76 | 2.23 |
| 315 NAPHTHALENE | .56 | .77 | .31 | |
| 326 DIETHYL PHTHALATE | 2.45 | 3.90 | 2.82 | 4.72 |
| 333 DI-N-BUTYL PHTHALATE | 1.80 | 1.85 | 5.50 | 4.56 |
| 337 BUTYL BENZYL PHTHALATE | | 2.93 | .49 | |
| 338 BIS(2-ETHYLHEXYL)PHTHALATE | 3.00 | 4.12 | | |
| 501 ANTIMONY | | .09 | (4.36) | |
| 502 ARSENIC | .50 | | | 5.38 |
| 504 CADMIUM | .48 | 1.15 | 1.36 | |
| 505 CHROMIUM | .26 | .67 | 2.11 | 1.20 |
| 506 COPPER | 2.46 | 3.45 | 2.02 | 1.08 |
| 507 LEAD | 6.24 | .62 | .82 | 2.41 |
| 508 MANGANESE | .79 | 1.44 | .74 | 1.32 |
| 509 MERCURY | (1.56) | (1.66) | (.86) | |
| 510 NICKEL | .24 | .44 | 1.36 | .40 |
| 511 SELENIUM | 1.56 | 1.88 | | |
| 512 SILVER | 1.92 | 1.45 | 2.41 | 4.34 |
| 513 THALLIUM | | | | |
| 514 ZINC | .79 | 1.30 | .87 | 1.56 |
| 601 TOTAL CYANIDES | .10 | .95 | 3.62 | 2.07 |
| 602 TOTAL PHENOLS | 2.71 | 1.43 | .73 | 1.10 |
| 703 AMMONIA | 2.41 | 1.96 | 2.57 | 2.28 |
| 704 OIL AND GREASE | 2.41 | 4.07 | 3.20 | 2.49 |
| 705 TSS | 3.09 | 2.68 | 1.51 | 2.85 |
| 706 TOC | 3.94 | 1.83 | 1.75 | 2.89 |
| 707 COD | 3.65 | 2.02 | 2.27 | 2.21 |
| 708 BOD | 5.06 | 1.66 | 1.75 | 2.62 |

to obtain these data, in addition to scaling errors, it is estimated through an accumulation of errors analysis that pollutants whose SUM/INF value falls in the 0.5-2.0 range are in balance.

In Table 39, various comparisons of the degree of balance between cities have been made (part A). Additional comparisons were made by analysis category (part B) to see if some types balanced better than others, and by examining those which balance in a given percentage of the cities (part C). On the whole, the priority pollutants balance one-half to two-thirds of the time, for the cases where the influent mass flow was high enough to conduct the comparison. A much larger number of pollutants "balance" if the error range is opened to a factor of 4, i.e., 0.25x - 4x. This range would appear to be suggested by the magnitude of the variance in the average index values, which is about equal to the value in most cases.

More than 50% of the volatiles data at the influent were too low to be treated in this manner, although many of these pollutants were observed in the sources. For cases where the INF volatiles levels are measurable, they balance 12 out of 26 times. They project high 2 out of 26 times and low 12 out of 26 times.

The acids and base/neutrals balance 10 out of 23 times and project high 11 out of 23 times. This pattern is reinforced by the classicals measurements which balance 7 out of 24 times and project high 17 out of 24 times. The classicals never project low.

These observations on the volatiles, acids, base/neutrals, and the classicals support the general considerations of raw wastewater collection systems which indicate that a large fraction of the "treatment" occurs in the collection system, in addition to that which occurs in the POTW. The data indicate that all of these groups are initially high at their source and undergo some degradation in the collection system before reaching the POTW. In many cases, the levels are low enough at the POTW not to be detected.

This hypothesis is supported by the data for the metals, which are always analyzed only as the element. These elements, therefore, should

## Table 39

## Summary of Mass Balance Comparisons

A. BY CITY

| Number of Pollutants (40 total) | Cincinnati | St. Louis | Atlanta | Hartford |
|---|---|---|---|---|
| Balance-priority pollutants | 10 | 16 | 13 | 10 |
| -classicals | 0 | 4 | 3 | 0 |
| Sources Greater-priority pollutants | 7 | 5 | 5 | 7 |
| -classicals | 6 | 2 | 3 | 6 |
| Influent Greater-priority pollutants | 4 | 7 | 8 | 1 |
| -classicals | 0 | 0 | 0 | 0 |
| Too Small at Influent to Balance | 4 | 5 | 3 | 0 |
| Less Than 0.01 Kg/day at Influent | 15 | 7 | 11 | 22 |

B. BALANCE BY ANALYSIS CATEGORY

| | Balance | Sources Greater | Influent Greater |
|---|---|---|---|
| Volatiles (26 values) | 12 | 2 | 12 |
| Acids, Base/Neutrals (5+18=23 values) | 10 | 11 | 2 |
| Metals (36 values) | 24 | 7 | 5 |
| Total Cyanides/Total Phenols (8 values) | 4 | 3 | 1 |
| Classicals (24 values) | 7 | 17 | 0 |

C. NUMBER OF POLLUTANTS WHICH BALANCE IN A GIVEN % OF CITIES

| | Priority Pollutants | | | |
|---|---|---|---|---|
| % of Cities | Organics | Metals | TCN/TP | Classicals |
| 100 | 2 | 4 | - | - |
| 75 | 0 | 1 | 1 | - |
| 66 | 3 | - | - | - |
| 50 | 7 | 5 | 1 | 2 |
| 33 | 2 | 4 | - | - |
| 25 | 1 | - | - | 3 |
| 0 | 5 | 1 | - | 1 |

be present in the influent at about the same level as the sources, even though their molecular association may be different. The metals balance 24 out of 36 observations and are about evenly projected high (7/36) and low (5/36) a small fraction of the time. On the average, the high projections are 3.7 times the influent and the low projections are 0.26 times the influent. All but 2 of the total of these 12 out-of-balance values fall within a factor of 4 range of the influent value.

A further comparison of this data can be made, within the uncertainties imposed by the mass balance by comparing the relative contribution of each source type for each pollutant (similar to what was done for the hypothetical cases). These ratios for the sources within the cities are given in Tables 40-43, along with the SUM value in Kg/day ($10^3$ Kg/day for the classicals). This type of comparison could be viewed as the analysis of basins whose mix of source types was actually as represented by the average character of the source sites sampled for each category and scaled by the actual source flows for these cities.

For "Cincinnati" (Table 40), the residential sources dominate the pollutant mass flow, but the area is predominantly residential. For "St. Louis" (Table 41), residential sources are still important, but many toxic pollutants are dominated by the industrial category, even though it only has about 12% of the flow. The industrial category dominance of "Atlanta" (Table 42), is clear from this presentation. "Hartford" (Table 43), with a small (7%) industrial component, shows a balance in the importance of each of the source types.

## Table 40

### Cincinnati Distribution of Pollutant Loading
### (91% Residential, 8% Commercial, 1% Industrial Flow)

| Pollutant | Fraction of SUM RES | Fraction of SUM COM | Fraction of SUM IND | SUM (Kg/day)* |
|---|---|---|---|---|
| 110 1,1-*DICHLOROETHYLENE* | .00 | .15 | .85 | .01 |
| 111 1,1-*DICHLOROETHANE* | .00 | .25 | .75 | .00 |
| 112 *TRANS*-1,2-*DICHLOROETHYLENE* | .00 | .50 | .50 | .01 |
| 113 *CHLOROFORM* | .88 | .10 | .02 | .20 |
| 114 1,2-*DICHLOROETHANE* | .66 | .22 | .13 | .00 |
| 115 1,1,1-*TRICHLOROETHANE* | .53 | .10 | .37 | .08 |
| 116 *CARBON TETRACHLORIDE* | .00 | .02 | .98 | .01 |
| 117 *BROMODICHLOROMETHANE* | .45 | .45 | .10 | .01 |
| 120 *TRICHLOROETHYLENE* | .49 | .41 | .11 | .09 |
| 121 *BENZENE* | .57 | .40 | .03 | .02 |
| 123 *DIBROMOCHLOROMETHANE* | .40 | .49 | .11 | .00 |
| 125 *BROMOFORM* | .00 | .00 | .00 | .00 |
| 127 1,1,2,2-*TETRACHLOROETHYLENE* | .81 | .13 | .06 | .46 |
| 128 *TOLUENE* | .77 | .14 | .09 | .22 |
| 129 *CHLOROBENZENE* | .89 | .03 | .08 | .00 |
| 130 *ETHYL BENZENE* | .34 | .12 | .54 | .07 |
| 203 *PHENOL* | .90 | .02 | .08 | .61 |
| 204 2,4-*DIMETHYLPHENOL* | .55 | .00 | .45 | .06 |
| 210 *PENTACHLOROPHENOL* | .88 | .10 | .02 | .17 |
| 301 *DICHLOROBENZENES* | .43 | .07 | .49 | .28 |
| 315 *NAPHTHALENE* | .67 | .09 | .24 | .08 |
| 326 *DIMETHYL PHTHALATE* | .98 | .02 | .00 | 1.05 |
| 333 *DI-N-BUTYL PHTHALATE* | .93 | .04 | .03 | .84 |
| 337 *BUTYL BENZYL PHTHALATE* | .84 | .05 | .11 | .56 |
| 338 *BIS(2-ETHYLHEXYL)PHTHALATE* | .92 | .04 | .03 | .49 |
| 501 *ANTIMONY* | .99 | .00 | .00 | .19 |
| 502 *ARSENIC* | .99 | .01 | .00 | .64 |
| 504 *CADMIUM* | .78 | .04 | .18 | .04 |
| 505 *CHROMIUM* | .71 | .11 | .18 | 1.45 |
| 506 *COPPER* | .97 | .03 | .01 | 5.64 |
| 507 *LEAD* | .93 | .04 | .03 | 3.65 |
| 508 *MANGANESE* | .93 | .06 | .01 | 10.01 |
| 509 *MERCURY* | .93 | .05 | .03 | .02 |
| 510 *NICKEL* | .75 | .11 | .13 | .30 |
| 511 *SELENIUM* | .97 | .03 | .00 | .31 |
| 512 *SILVER* | .75 | .03 | .22 | .26 |
| 513 *THALLIUM* | .00 | .91 | .09 | .00 |
| 514 *ZINC* | .94 | .04 | .03 | 10.93 |
| 601 *TOTAL CYANIDES* | .77 | .00 | .22 | .15 |
| 602 *TOTAL PHENOLS* | .93 | .04 | .03 | 2.48 |
| 703 *AMMONIA* | .97 | .02 | .00 | 1.23 |
| 704 *OIL AND GREASE* | .92 | .07 | .01 | 4.33 |
| 705 *TSS* | .96 | .03 | .01 | 11.93 |
| 706 *TOC* | .95 | .05 | .01 | 6.24 |
| 707 *COD* | .95 | .05 | .01 | 21.25 |
| 708 *BOD* | .94 | .05 | .01 | 8.88 |

*Classicals in $10^3$ kg/day.

## Table 41

### St. Louis Distribution of Pollutant Loading
### (80% Residential, 9% Commercial, 11% Industrial Flow)

| Pollutant | Fraction of SUM | | | SUM (Kg/day)* |
|---|---|---|---|---|
| | RES | COM | IND | |
| 110 1,1-DICHLOROETHYLENE | .00 | .02 | .98 | .12 |
| 111 1,1-DICHLOROETHANE | .00 | .03 | .97 | .02 |
| 112 TRANS-1,2-DICHLOROETHYLENE | .00 | .10 | .90 | .14 |
| 113 CHLOROFORM | .68 | .10 | .22 | .58 |
| 114 1,2-DICHLOROETHANE | .26 | .12 | .62 | .01 |
| 115 1,1,1-TRICHLOROETHANE | .10 | .02 | .88 | 1.03 |
| 116 CARBON TETRACHLORIDE | .00 | .00 | 1.00 | .30 |
| 117 BROMODICHLOROMETHANE | .20 | .27 | .53 | .03 |
| 120 TRICHLOROETHYLENE | .20 | .23 | .56 | .48 |
| 121 BENZENE | .40 | .38 | .22 | .06 |
| 123 DIBROMOCHLOROMETHANE | .17 | .28 | .55 | .02 |
| 125 BROMOFORM | .00 | .00 | .00 | .00 |
| 127 1,1,2,2-TETRACHLOROETHYLENE | .48 | .10 | .42 | 1.77 |
| 128 TOLUENE | .37 | .09 | .53 | 1.03 |
| 129 CHLOROBENZENE | .46 | .02 | .52 | .02 |
| 130 ETHYL BENZENE | .05 | .02 | .93 | 1.14 |
| 203 PHENOL | .46 | .01 | .53 | 2.73 |
| 204 2,4-DIMETHYLPHENOL | .09 | .00 | .91 | .85 |
| 210 PENTACHLOROPHENOL | .68 | .10 | .22 | .49 |
| 301 DICHLOROBENZENES | .06 | .02 | .92 | 4.31 |
| 315 NAPHTHALENE | .18 | .03 | .79 | .68 |
| 326 DIETHYL PHTHALATE | .98 | .02 | .00 | 2.40 |
| 333 DI-N-BUTYL PHTHALATE | .69 | .04 | .27 | 2.59 |
| 337 BUTYL BENZYL PHTHALATE | .36 | .03 | .60 | 2.93 |
| 338 BIS(2-ETHYLHEXYL)PHTHALATE | .67 | .04 | .29 | 1.56 |
| 501 ANTIMONY | .95 | .01 | .04 | .44 |
| 502 ARSENIC | .96 | .02 | .02 | 1.49 |
| 504 CADMIUM | .25 | .02 | .73 | .30 |
| 505 CHROMIUM | .23 | .05 | .73 | 10.35 |
| 506 COPPER | .87 | .03 | .09 | 14.16 |
| 507 LEAD | .67 | .04 | .29 | 11.57 |
| 508 MANGANESE | .83 | .08 | .10 | 25.56 |
| 509 MERCURY | .69 | .05 | .27 | .07 |
| 510 NICKEL | .29 | .06 | .65 | 1.77 |
| 511 SELENIUM | .95 | .04 | .01 | .71 |
| 512 SILVER | .22 | .01 | .77 | 2.06 |
| 513 THALLIUM | .00 | .54 | .46 | .00 |
| 514 ZINC | .69 | .04 | .27 | 33.31 |
| 601 TOTAL CYANIDES | .22 | .00 | .78 | 1.22 |
| 602 TOTAL PHENOLS | .68 | .04 | .28 | 7.70 |
| 703 AMMONIA | .93 | .03 | .04 | 2.93 |
| 704 OIL AND GREASE | .82 | .08 | .10 | 11.14 |
| 705 TSS | .89 | .04 | .08 | 29.54 |
| 706 TOC | .85 | .06 | .09 | 15.70 |
| 707 COD | .84 | .05 | .10 | 54.42 |
| 708 BOD | .84 | .06 | .10 | 22.68 |

*Classicals in $10^3$ kg/day.

## Table 42

## Atlanta Distribution of Pollutant Loading
## (52% Residential, 26% Commercial, 22% Industrial Flow)

| Pollutant | Fraction of SUM RES | COM | IND | SUM (Kg/day)* |
|---|---|---|---|---|
| 110 1,1-DICHLOROETHYLENE | .00 | .03 | .97 | .75 |
| 111 1,1-DICHLOROETHANE | .00 | .05 | .95 | .10 |
| 112 TRANS-1,2-DICHLOROETHYLENE | .00 | .13 | .87 | .85 |
| 113 CHLOROFORM | .38 | .25 | .38 | 2.01 |
| 114 1,2-DICHLOROETHANE | .10 | .19 | .71 | .05 |
| 115 1,1,1-TRICHLOROETHANE | .03 | .04 | .93 | 5.78 |
| 116 CARBON TETRACHLORIDE | .00 | .00 | 1.00 | 1.80 |
| 117 BROMODICHLOROMETHANE | .06 | .39 | .54 | .18 |
| 120 TRICHLOROETHYLENE | .07 | .34 | .59 | 2.73 |
| 121 BENZENE | .14 | .61 | .24 | .32 |
| 123 DIBROMOCHLOROMETHANE | .05 | .40 | .55 | .13 |
| 125 BROMOFORM | .00 | .00 | .00 | .00 |
| 127 1,1,2,2-TETRACHLOROETHYLENE | .21 | .21 | .58 | 7.60 |
| 128 TOLUENE | .15 | .17 | .68 | 4.84 |
| 129 CHLOROBENZENE | .22 | .04 | .74 | .08 |
| 130 ETHYL BENZENE | .02 | .03 | .95 | 6.65 |
| 203 PHENOL | .21 | .03 | .76 | 11.31 |
| 204 2,4-DIMETHYLPHENOL | .03 | .00 | .97 | 4.80 |
| 210 PENTACHLOROPHENOL | .38 | .25 | .37 | 1.70 |
| 301 DICHLOROBENZENES | .02 | .02 | .96 | 24.80 |
| 315 NAPHTHALENE | .06 | .05 | .88 | 3.62 |
| 326 DIETHYL PHTHALATE | .92 | .08 | .00 | 4.95 |
| 333 DI-N-BUTYL PHTHALATE | .40 | .10 | .50 | 8.50 |
| 337 BUTYL BENZYL PHTHALATE | .15 | .06 | .79 | 13.43 |
| 338 BIS(2-ETHYLHEXYL)PHTHALATE | .38 | .11 | .51 | 5.27 |
| 501 ANTIMONY | .86 | .02 | .11 | .94 |
| 502 ARSENIC | .88 | .06 | .06 | 3.15 |
| 504 CADMIUM | .10 | .03 | .87 | 1.50 |
| 505 CHROMIUM | .09 | .04 | .84 | 53.60 |
| 506 COPPER | .67 | .11 | .22 | 35.70 |
| 507 LEAD | .38 | .09 | .52 | 38.93 |
| 508 MANGANESE | .57 | .23 | .20 | 71.87 |
| 509 MERCURY | .40 | .12 | .48 | .24 |
| 510 NICKEL | .11 | .10 | .78 | 8.75 |
| 511 SELENIUM | .81 | .15 | .03 | 1.60 |
| 512 SILVER | .08 | .02 | .90 | 10.55 |
| 513 THALLIUM | .00 | .62 | .34 | .01 |
| 514 ZINC | .41 | .09 | .50 | 108.69 |
| 601 TOTAL CYANIDES | .08 | .00 | .92 | 6.24 |
| 602 TOTAL PHENOLS | .39 | .11 | .50 | 25.64 |
| 703 AMMONIA | .78 | .12 | .10 | 6.71 |
| 704 OIL AND GREASE | .54 | .25 | .21 | 32.16 |
| 705 TSS | .69 | .12 | .19 | 73.06 |
| 706 TOC | .62 | .19 | .20 | 41.82 |
| 707 COD | .60 | .17 | .23 | 147.48 |
| 708 BOD | .59 | .19 | .22 | 61.97 |

*Classicals in $10^3$ kg/day.

Table 43

Hartford Distribution of Pollutant Loading
(64% Residential, 27% Commercial, 9% Industrial Flow)

| Pollutant | Fraction of SUM<br>RES | <br>COM | <br>IND | SUM (Kg/day)* |
|---|---|---|---|---|
| 110 1,1-*DICHLOROETHYLENE* | .00 | .07 | .93 | .18 |
| 111 1,1-*DICHLOROETHANE* | .00 | .12 | .88 | .03 |
| 112 *TRANS*-1,2-*DICHLOROETHYLENE* | .00 | .29 | .71 | .24 |
| 113 *CHLOROFORM* | .53 | .30 | .17 | 1.05 |
| 114 1,2-*DICHLOROETHANE* | .20 | .34 | .46 | .02 |
| 115 1,1,1-*TRICHLOROETHANE* | .09 | .09 | .82 | 1.54 |
| 116 *CARBON TETRACHLORIDE* | .00 | .01 | .99 | .42 |
| 117 *BROMODICHLOROMETHANE* | .11 | .59 | .30 | .08 |
| 120 *TRICHLOROETHYLENE* | .12 | .54 | .34 | 1.11 |
| 121 *BENZENE* | .19 | .70 | .10 | .18 |
| 123 *DIBROMOCHLOROMETHANE* | .09 | .60 | .31 | .06 |
| 125 *BROMOFORM* | .00 | .00 | .00 | .00 |
| 127 1,1,2,2-*TETRACHLOROETHYLENE* | .37 | .31 | .32 | 3.23 |
| 128 *TOLUENE* | .30 | .28 | .42 | 1.83 |
| 129 *CHLOROBENZENE* | .44 | .07 | .49 | .03 |
| 130 *ETHYL BENZENE* | .04 | .08 | .87 | 1.70 |
| 203 *PHENOL* | .45 | .05 | .50 | 4.01 |
| 204 2,4-*DIMETHYLPHENOL* | .09 | .00 | .91 | 1.20 |
| 210 *PENTACHLOROPHENOL* | .53 | .30 | .17 | .89 |
| 301 *DICHLOROBENZENES* | .06 | .06 | .88 | 6.31 |
| 315 *NAPHTHALENE* | .16 | .12 | .72 | 1.04 |
| 326 *DIETHYL PHTHALATE* | .93 | .07 | .00 | 3.62 |
| 333 *DI-N-BUTYL PHTHALATE* | .62 | .13 | .24 | 4.06 |
| 337 *BUTYL BENZYL PHTHALATE* | .34 | .11 | .55 | 4.50 |
| 338 *BIS*(2-*ETHYLHEXYL*)*PHTHALATE* | .60 | .14 | .26 | 2.47 |
| 501 *ANTIMONY* | .94 | .02 | .04 | .64 |
| 502 *ARSENIC* | .92 | .05 | .02 | 2.21 |
| 504 *CADMIUM* | .25 | .06 | .69 | .44 |
| 505 *CHROMIUM* | .20 | .16 | .64 | 16.52 |
| 506 *COPPER* | .80 | .12 | .08 | 22.01 |
| 507 *LEAD* | .61 | .13 | .26 | 18.11 |
| 508 *MANGANESE* | .68 | .24 | .08 | 44.05 |
| 509 *MERCURY* | .61 | .16 | .23 | .12 |
| 510 *NICKEL* | .25 | .20 | .55 | 2.92 |
| 511 *SELENIUM* | .85 | .14 | .01 | 1.13 |
| 512 *SILVER* | .21 | .05 | .74 | 2.99 |
| 513 *THALLIUM* | .00 | .82 | .18 | .01 |
| 514 *ZINC* | .63 | .12 | .24 | 51.97 |
| 601 *TOTAL CYANIDES* | .22 | .01 | .77 | 1.73 |
| 602 *TOTAL PHENOLS* | .61 | .14 | .25 | 12.19 |
| 703 *AMMONIA* | .86 | .11 | .03 | 4.54 |
| 704 *OIL AND GREASE* | .66 | .26 | .08 | 19.57 |
| 705 *TSS* | .81 | .12 | .07 | 46.23 |
| 706 *TOC* | .74 | .19 | .07 | 25.97 |
| 707 *COD* | .73 | .18 | .09 | 89.23 |
| 708 *BOD* | .72 | .20 | .08 | 37.78 |

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*Classicals in $10^3$ kg/day.

## D. Examination of Variances and Correlations

The design of the sampling plan has provided an opportunity to examine some of the secondary objectives, while the restrictions imposed by the site characteristics or other factors, such as weather, limited the ability to examine other objectives. Some of the differences between weekday and weekend effects and old and new residential sources are summarized in this section. Some limited runoff results obtained during the Hartford study are discussed.

### 1. Weekday/Weekend Differences

An exploratory test of differences between weekday and weekend samples suggests that, in the aggregate, priority pollutants are found more frequently in weekday than weekend samples. This result is indicated for all source types and for the influent. A contingency table was formed separately for each source type over all cities and over all pollutants. These tables display the number of pollutants detected vs. the number of pollutants not detected, summed over all samples and all pollutants separately for weekday samples and weekend samples.

|  | detections | non-detections |
|---|---|---|
| weekdays | $n_1$ | $n_2$ |
| weekends | $n_3$ | $n_4$ |

Under the null hypothesis that the day of the week does not affect the likelihood of any particular pollutant being present, the fraction of weekday detections $\left(\frac{n_1}{n_1 + n_2}\right)$ would be approximately equal to the fraction of weekend detections $\left(\frac{n_3}{n_3 + n_4}\right)$.

For each source type, weekday samples slightly exceeded weekend samples in the frequency of detections as follows:

|  | Residential | Commercial | Industrial | All Source Sites | Influent |
|---|---|---|---|---|---|
| weekday fraction of detections | 14% | 15% | 24% | 16% | 19% |
| weekend fraction of detections | 12% | 13% | 21% | 14% | 17% |

This small but consistent difference is statistically significant at the 95% level (given the simplifying assumption of independence of all pollutants and all samples) when considering all aggregated source sites. This procedure only considers the relationship of day of the week with the absence or presence of pollutants and does not address the concentrations of pollutants.

## 2. Old vs. New Residential Comparisons

The sampled residential areas have been separated by the approximate age of housing into old and new residential areas. This initial comparison was performed on an average mass per capita basis separately for each pollutant, and on the basis of frequency of detection across all pollutants.

Table 44 shows the average mass per capita in mg/person/day for the 6 new residential sites and the 5 old residential sites sampled over the four cities. Also displayed is the ratio of the averages to the greater of the two averages for each pollutant. The majority of pollutants show higher per capita mass contributions from old residential areas.

A contingency table was formed to display the number of detections of pollutants at old residential vs. new residential sites.

|  | detections | non-detections |
|---|---|---|
| new residential | $n_1$ | $n_2$ |
| old residential | $n_3$ | $n_4$ |

If the age of housing were independent of the number of detections found at the sampling site, then the ratio of detections to total samples

## Table 44

## Old and New Residential Mass Discharge Rates

| | Mg/person/day* | | Ratio | |
|---|---|---|---|---|
| | New | Old | New | Old |
| 110 1,1-DICHLOROETHYLENE | .00 | .00 | | |
| 111 1,1-DICHLOROETHANE | .00 | .00 | | |
| 112 TRANS-1,2-DICHLOROETHYLENE | .00 | .00 | | |
| 113 CHLOROFORM | 1.48 | 2.38 | .62 | 1.00 |
| 114 1,2-DICHLOROETHANE | .00 | .07 | .00 | 1.00 |
| 115 1,1,1-TRICHLOROETHANE | 2.36 | .23 | 1.00 | .10 |
| 116 CARBON TETRACHLORIDE | .00 | .00 | | |
| 117 BROMODICHLOROMETHANE | .00 | .09 | .00 | 1.00 |
| 120 TRICHLOROETHYLENE | .43 | .03 | 1.00 | .08 |
| 121 BENZENE | .03 | .27 | .12 | 1.00 |
| 123 DIBROMOCHLOROMETHANE | .00 | .06 | .00 | 1.00 |
| 125 BROMOFORM | .00 | .00 | | |
| 127 1,1,2,2-TETRACHLOROETHYLENE | 3.19 | 3.25 | .98 | 1.00 |
| 128 TOLUENE | .75 | 3.42 | .22 | 1.00 |
| 129 CHLOROBENZENE | .00 | .12 | .00 | 1.00 |
| 130 ETHYL BENZENE | .06 | .70 | .08 | 1.00 |
| 203 PHENOL | 1.43 | 10.31 | .14 | 1.00 |
| 204 2,4-DIMETHYLPHENOL | .14 | .58 | .24 | 1.00 |
| 210 PENTACHLOROPHENOL | 1.55 | .00 | 1.00 | .00 |
| 301 DICHLOROBENZENES | .82 | 2.22 | .37 | 1.00 |
| 315 NAPHTHALENE | .00 | 3.46 | .00 | 1.00 |
| 326 DIETHYL PHTHALATE | 6.56 | 14.29 | .46 | 1.00 |
| 333 DI-N-BUTYL PHTHALATE | 8.24 | 6.32 | 1.00 | .77 |
| 337 BUTYL BENZYL PHTHALATE | 3.72 | 6.52 | .57 | 1.00 |
| 338 BIS(2-ETHYLHEXYL)PHTHALATE | 1.94 | 10.50 | .18 | 1.00 |
| 501 ANTIMONY | 1.19 | 1.41 | .84 | 1.00 |
| 502 ARSENIC | 5.43 | 6.22 | .87 | 1.00 |
| 504 CADMIUM | 1.24 | 1.01 | 1.00 | .82 |
| 505 CHROMIUM | 6.82 | 25.22 | .27 | 1.00 |
| 506 COPPER | 56.25 | 69.57 | .81 | 1.00 |
| 507 LEAD | 15.67 | 116.31 | .13 | 1.00 |
| 508 MANGANESE | 86.88 | 100.23 | .87 | 1.00 |
| 509 MERCURY | .20 | .21 | .95 | 1.00 |
| 510 NICKEL | 1.44 | 3.58 | .40 | 1.00 |
| 511 SELENIUM | 2.16 | 3.04 | .71 | 1.00 |
| 512 SILVER | 1.94 | .15 | 1.00 | .08 |
| 513 THALLIUM | .00 | .00 | | |
| 514 ZINC | 79.13 | 219.89 | .36 | 1.00 |
| 601 TOTAL CYANIDES | 1.20 | .22 | 1.00 | .18 |
| 602 TOTAL PHENOLS | 16.48 | 34.99 | .47 | 1.00 |
| 703 AMMONIA | 11.24 | 11.87 | .95 | 1.00 |
| 704 OIL AND GREASE | 26.37 | 89.24 | .30 | 1.00 |
| 705 TSS | 81.43 | 176.99 | .46 | 1.00 |
| 706 TOC | 54.70 | 69.54 | .79 | 1.00 |
| 707 COD | 199.84 | 218.88 | .91 | 1.00 |
| 708 BOD | 76.18 | 103.99 | .73 | 1.00 |

*Classicals in kg/day.

$\left(\frac{n_1}{n_1 + n_2}\right)$ and $\left(\frac{n_3}{n_3 + n_4}\right)$ should be approximately equal for new and old residential areas, i.e., the presence of pollutants would be about the same. For all four cities and all pollutants aggregated, 12% of pollutants tested were detected in new residential areas versus 13% in old residential. This small difference is not consistent among the cities taken separately and is not statistically significant in the aggregate. Age of housing appears to affect the level of mass contribution from residential, but has little effect on the frequency of presence of pollutants.

### 3. Runoff

During the Hartford study, a limited amount of information was obtained on the effect of rain on the mass flow rate of certain metals in the collection system. The data base was very limited and thus the conclusions are tentative.

The mass flow rates for lead, zinc, and manganese were observed to increase during the rain event. Lead and zinc, and perhaps manganese, are known automotive sources and it is therefore not a surprise that they were found to increase.

## VI. CONCLUSIONS

Perhaps the most important conclusion from this study is that relatively few toxic pollutants were found in the sources and many were at low concentration levels. Only fifty-six priority pollutants were observed. Sixty-seven pollutants were never detected and an additional twenty were detected less than ten percent of the time.

Tap water contributed only trihalomethanes and copper. Residential sources had high zinc and manganese levels, plus some other metals. Commercial sources were quite similar to residential sources, but did have some additional pollutants and a few more metals. The industrial sources had high concentrations of many of the detected organic pollutants and all of the observed metals were present in this source category.

The data have been used to develop indices for each source category which could be used to compare the impact of different proportions of source types on POTW influents. The indices appear reliable for the residential and commercial sources, but are only approximate indicators for the industrial sources, because of the extremely variable and specific nature of industrial source types.

The indices have been used to calculate relative source strengths and loadings on POTW's for a number of hypothetical drainage basins. These calculations clearly reflect the impact of industrialization of a basin, but also show the dominant role played by residential and commercial sources for some pollutants. Reasonable success was achieved in applying the source indices to the four cities studied, to make a mass balance comparison with the measured POTW influent values.

The frequency of observation of pollutants is consistently lower on weekends than on weekdays. Old residential sources contribute higher levels of pollutants than new residential sources.

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# VII. RECOMMENDATIONS

Further analyses should be carried out on the data base which has been developed to search for other effects and correlations.

The indices and approaches developed in this study should be used to examine available data for industrialized cities.

This source data should be integrated with the POTW plant data to enable a complete analysis of the POTW situation.

Further sampling efforts should be designed to test the findings summarized in this report. Any future studies should also attempt to develop a more complete understanding of industrial sources and their impact on POTW loading.

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## VIII. REFERENCES

1. "Sources of Toxic Pollutants Found in Influents to Sewage Treatment Plants" I. Literature Review, EPA, MDSD, Final Report on Task Order No. 6, Contract No. 68-01-3857, Report No. ADL 81099-50, June, 1979.
2. "Sources of Toxic Pollutants Found in Influents to Sewage Treatment Plants" II. Muddy Creek Drainage Basin, Cincinnati, Ohio, EPA, MDSD, Final Report on Task Order No. 6, Contract No. 68-01-3857, Report No. ADL 81099-51, June, 1979.
3. "Sources of Toxic Pollutants Found in Influents to Sewage Treatment Plants" III. Coldwater Creek Drainage Basin, St. Louis, MO., EPA, MDSD, Final Report on Task Order No. 10 Contract No. 68-01-3857, Report No. ADL 81099-16, October, 1979.
4. "Sources of Toxic Pollutants Foune in Influents to Sewage Treatment Plants" IV. R.M. Clayton Drainage Basin, Atlanta, Georgia, EPA, MDSD, Final Report on Task Order No. 13, Contract No. 68-01-3857, Report No. ADL 81099-26, October, 1979.
5. "Sources of Toxic Pollutants Found in Influents to Sewage Treatment Plants" V. Hartford WPCP Drainage Basin, Hartford, Connecticut, EPA, MDSD, Final Report on Task Order No. 13, Contract No. 68-01-3857, Report No. ADL 81099-46, November, 1979.
6. "Sampling and Analysis Procedures for Screening of Industrial Effluents for Priority Pollutants", U.S. EPA, EMSL, Cincinnati, Ohio, March, 1977, revised April, 1977.
7. "Quality Assurance Program for the Analyses of Chemical Constituents in Environmental Samples", U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio, March, 1978.

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# APPENDIX A

## Individual Pollutant Reporting Limits, Recovery and Precision Data

The data in these tables summarize the results that were obtained for each pollutant reviewed over all four cities, for which reference compounds were available. These data are the results obtained in the raw wastewater samples. The reporting limits were the same for each city where a single value is indicated, otherwise the range reported over the four cities is given. The average recovery values reported are the means over all four cities. The precision (relative standard deviation) is given as the range of values observed in all of the cities. In general, the precision of the data improved throughout the program; the recovery values stayed consistently high for all four cities and low reporting limits were consistently achieved.

The quality control data are very good for the majority of the priority pollutants. The priority pollutants for which the EPA Screening Protocol was problematic are listed below along with their respective problems. These priority pollutants are indicated by footnote, in the tables. The footnote definitions are:

(a) These priority pollutants were never detected using the EPA Screening Protocol. Therefore, if these compounds were present in the samples from the four surveys they would not have been detected.

Bis(chloromethyl)ether - very short half life in water.

2-Chloroethyl vinyl ether - volatile (bp 109°C) causing erratic recoveries during Kuderna Danish concentration.

Hexachlorocyclopentadiene - Possible high GC/MS reporting limit or degradation in the heated GC injector.

(b) These priority pollutants were sporadically not detected using the EPA Screening Protocol. Consequently, accuracy and precision data are poor. The analytical results for these compounds in the four surveys may not be reliable. The problem for most of these

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compounds is related to poor chromatography. The compounds for which this was particularly problematic are:

Benzidine - poor chromatography, heat labile, unstable in methylene chloride (problematic in Cincinnati, St. Louis, Atlanta and Hartford).

N-nitrosodimethylamine - poor chromatography, high GC/MS reporting limit, poor extraction efficiency from water into methylene chloride (problematic in Cincinnati, St. Louis, Atlanta).

2,4-Dinitrophenol - poor chromatography.

4,6-Dinitro-2-cresol - poor chromatography (problematic in Atlanta, Hartford).

4-Nitrophenol - poor chromatography (problematic in Cincinnati and Hartford).

(c) These volatile priority pollutants were not detected until the PAT/GC/MS procedure was modified during the Atlanta study. Therefore if these compounds were present in samples from Cincinnati or St. Louis they would not have been detected. Also during the Atlanta study precision and accuracy were poor. Therefore the quantitative analytical results are not reliable.

Dichlorodifluoromethane - broke through sorbent trap (also occurred in Atlanta study).

Bromomethane - broke through sorbent trap.

Vinyl chloride - broke through sorbent trap.

Chloroethane - broke through sorbent trap.

The analytical method for those compounds just listed was improved for the last city and reliable data are available from the Hartford samples for these pollutants.

(d) The analytical results for methylene chloride are erratic due to sporadic contamination from the field and laboratory. This problem was finally brought under control during the Hartford study.

(e) Reference standards were never available for these priority pollutants. It may be implied from QC data or similar compounds that these priority pollutants would have been detected if they were present in the samples.

2,3,7,8-TCDD

Bis(2-chloroisopropyl)ether.

The reference standards that were not available for all four cities surveyed but available for some, are so indicated in the following Tables.

## Table A-1

## SUMMARY OF QUALITY CONTROL DATA

### Volatiles

| Compound | Reporting Limit µg/L | Average Recovery | Range of Relative Standard Deviations |
|---|---|---|---|
| 101. Chloromethane[c*] | 5* | 118* | 21* |
| 102. Dichlorodifluoromethane[c] | 5* | 194* | 48* |
| 103. Bromomethane[c] | 5* | 113* | 22* |
| 104. Vinyl chloride[c] | 5* | 123* | 19* |
| 105. Chloroethane[c] | 5* | 108* | 15* |
| 106. Methylene chloride[d] | 1 | 138 | 12-259 |
| 107. Acrolein | 1-7 | 58 | 35-149 |
| 108. Trichlorofluoromethane | 1-6 | 78 | 11-83 |
| 109. Acrylonitrile | 1 | 94 | 8-24 |
| 110. 1,1-Dichloroethylene | 1-5 | 72 | 4-134 |
| 111. 1,1-Dichloroethane | 1-2 | 83 | 2-43 |
| 112. Trans-1,2-dichloroethylene | 1 | 73 | 3-73 |
| 113. Chloroform | 1 | 82 | 5-38 |
| 114. 1,2-Dichloroethane | 1 | 96 | 4-35 |
| 115. 1,1,1-Trichloroethane | 1 | 82 | 10-78 |
| 116. Carbon tetrachloride | 1 | 87 | 6-44 |
| 117. Bromodichloromethane | 1 | 88 | 5-24 |
| 118. 1,2-Dichloropropane | 1 | 82 | 3-37 |
| 119. Trans-1,3-dichloropropylene | 1 | 82 | 4-11 |
| 120. Trichloroethylene | 1-2 | 98 | 2-78 |
| 121. Benzene | 1 | 89 | 5-17 |
| 122. Cis-1,3-dichloropropylene | 1 | 85 | 3-20 |
| 123. Dibromochloromethane | 1-2 | 95 | 4-24 |
| 124. 1,1,2-Trichloroethane | 1 | 99 | 2-13 |
| 125. Bromoform | 1-3 | 74 | 7-37 |
| 126. 1,1,2,2-Tetrachloroethane | 1 | 78 | 4-75 |
| 127. 1,1,2,2-Tetrachloroethylene | 1 | 94 | 8-79 |
| 128. Toluene | 1 | 102 | 3-32 |
| 129. Chlorobenzene | 1 | 106 | 2-29 |
| 130. Ethyl benzene | 1 | 113 | 2-47 |

* Hartford data only

## Table A-2

## SUMMARY OF QUALITY CONTROL DATA

### Acids

| Compound | Reporting Limit μg/L | Average Recovery | Range of Relative Standard Deviations |
|---|---|---|---|
| 201. 2–Chlorophenol | 10 | 86 | 6-29 |
| 202. 2–Nitrophenol | 10-15 | 93 | 8-26 |
| 203. Phenol | 10 | 60 | 20-26 |
| 204. 2,4–Dimethylphenol | 10 | 90 | 5-20 |
| 205. 2,4–Dichlorophenol | 10 | 103 | 9-15 |
| 206. 2,4,6–Trichlorophenol | 10 | 92 | 7-18 |
| 207. 4–Chloro–3–cresol | 10 | 98 | 12-17 |
| 208. 2,4–Dinitrophenol [b] | 20-40 | 41 | 26-155 |
| 209. 4,6–Dinitro–2–cresol [b] | 20-40 | 57 | 23-112 |
| 210. Pentachlorophenol | 10-25 | 105 | 11-28 |
| 211. 4–Nitrophenol [b] | 10-25 | 54 | 11-42 |

## Table A-3

## SUMMARY OF QUALITY CONTROL DATA

### Base/Neutrals

| Compound | Reporting Limit µg/L | Average Recovery | Range of Relative Standard Deviations |
|---|---|---|---|
| 301. 1,3 Dichlorobenzene | 10-30 | 71 | 11-30 |
| 302. 1,4 Dichlorobenzene | | | |
| 303. 1,2 Dichlorobenzene | | | |
| 304. Hexachloroethane | 10-20 | 70 | 26-42 |
| 305. Bis(chloromethyl)ether [a] | - | - | - |
| 306. Bis(2-chloroethyl) ether | 10-20 | 78 | 10-39 |
| 307. Bis(2-chloroisopropyl) ether [e] | 10 | - | - |
| 308. N-Nitrosodimethylamine [c] | 70* | 37* | 78* |
| 309. Nitrosodi-n-propylamine | 10-20 | 89 | 9-27 |
| 310. Nitrobenzene | 10-20 | 78 | 10-28 |
| 311. Hexachlorobutadiene | 10 | 57 | 13-23 |
| 312. 1,2,4-Trichlorobenzene | 10-20 | 74 | 16-20 |
| 313. 2-Chloroethyl vinyl ether [a] | - | - | - |
| 314. Bis(2-chloroethoxy) methane | 10 | 92 | 10-44 |
| 315. Naphthalene | 10 | 81 | 14-43 |
| 316. Isophorone | 10 | 82 | 8-35 |
| 317. Hexachlorocyclopentadiene [a] | - | - | - |
| 318. 2-Chloronaphthalene | 10 | 81 | 15-27 |
| 319. Acenaphthylene | 10 | 85 | 12-21 |
| 320. Acenaphthene | 10 | 82 | 17-24 |
| 321. Dimethyl phthalate | 10 | 67 | 9-40 |
| 322. 2,6-Dinitrotoluene | 10 | 86 | 20-25 |
| 323. 4-Chlorophenyl phenyl ether | 10 | 74 | 18-29 |
| 324. Fluorene | 10 | 79 | 16-24 |
| 325. 2,4-Dinitrotoluene | 10 | 62 | 19-43 |
| 326. Diethyl phthalate | 10 | 91 | 19-34 |
| 327. 1,2-Diphenylhydrazine | 10 | 75 | 23-28 |
| 328. N-Nitrosodiphenylamine | 10 | 113 | 13-22 |
| 329. Hexachlorobenzene | 10 | 64 | 22-43 |
| 330. 4-Bromophenyl phenyl ether | 10 | 64 | 12-29 |

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* Hartford data only

## Table A-3 (Continued)

## SUMMARY OF QUALITY CONTROL DATA

### Base/Neutrals

| Compound | Reporting Limit µg/L | Average Recovery | Range of Relative Standard Deviations |
|---|---|---|---|
| 331. Anthracene | 5-10 | 82 | 14-23 |
| 332. Phenanthrene | | | |
| 333. Di-n-butyl phthalate | 10 | 74 | 28-81 |
| 334. Fluoranthene | 5-10 | 66 | 11-35 |
| 335. Pyrene | 5-10 | 67 | 14-35 |
| 336. Benzidine[b] | 10-20 | 18 | 95-111 |
| 337. Butyl benzyl phthalate | 10 | 45 | 33-57 |
| 338. Bis(2-ethylhexyl) phthalate | 10 | 42 | 29-84 |
| 339. Di-n-octyl phthalate | | | |
| 340. Chrysene | 5-10 | 59 | 13-30 |
| 341. Benzo(a)anthracene | | | |
| 342. 3,3'-Dichlorobenzidine | 10 | 80 | 15-27 |
| 343. Benzo(b)fluoranthene | 1-5 | 46 | 16-93 |
| 344. Benzo(k)fluoranthene | | | |
| 345. Benzo(a)pyrene | 5-10 | 51 | 18-34 |
| 346. Indeno (1,2,3-c,d) pyrene | 5 * | 29* | 19* |
| 347. Dibenzo (a,h) Anthracene | 5-10 | 50 | 17-60 |
| 348. Benzo (g,h,i) perylene | 5-10 | 40 | 20-245 |

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* Hartford data only

## Table A-4

## SUMMARY OF QUALITY CONTROL DATA

### Pesticides

| Compound | | Reporting Limit µg/L | Average Recovery | Range of Relative Standard Deviations |
|---|---|---|---|---|
| 401. | alpha-BHC | 1 | 77 | 8-28 |
| 402. | gamma-BHC | 1 | 78 | 7-43 |
| 403. | Heptachlor | 1 | 67 | 7-70 |
| 404. | beta-BHC | 1 | 80 | 5-42 |
| 405. | delta-BHC | 1 | 89 | 7-31 |
| 406. | Aldrin | 1 | 76 | 5-20 |
| 407. | Heptachlor epoxide | 1 | 80 | 5-18 |
| 408. | Endosulfan I. | 1 | 64 | 11-51 |
| 409. | DDE | 1 | 84 | 5-26 |
| 410. | Dieldrin | 1 | 48 | 6-39 |
| 411. | Endrin | 1 | 77 | 9-26 |
| 412. | DDD | 1 | 78 | 10-31 |
| 413. | Endosulfan II | | | |
| 414. | DDT | 1 | 76 | 8-21 |
| 415. | Endrin aldehyde | 1* | 60* | 29* |
| 416. | Endosulfan sulfate | 1* | 84* | 18* |
| 417. | Chlordane | | | |
| 418. | Toxaphene | | | |
| 419. | PCB-1221 | | | |
| 420. | PCB-1232 | | | |
| 421. | PCB-1242 | | | |
| 422 | PCB-1248 | | | |
| 423. | PCB-1254 | 1 | 86 | 7-18 |
| 424. | PCB-1260 | | | |
| 425. | PCB-1016 | | | |

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* Hartford data only

## Table A-5

## SUMMARY OF QUALITY CONTROL DATA

### Metals, Total Cyanides, Total Phenols

| Compound | Reporting Limit µg/L | Average Recovery | Range of Relative Standard Deviations |
|---|---|---|---|
| 501. Antimony | 1-3 | 73 | 25-48 |
| 502. Arsenic | 2-4 | 101 | 11-36 |
| 503. Beryllium | 1-3 | 69 | 6-13 |
| 504. Cadmium | 1-3 | 85 | 15-63 |
| 505. Chromium | 1-67 | 99 | 2-48 |
| 506. Copper | 4-9 | 103 | 9-12 |
| 507. Lead | 3-15 | 90 | 10-47 |
| 508. Manganese | 3-11 | 100 | 4-9 |
| 509. Mercury | 1-2 | 73 | 7-34 |
| 510. Nickel | 1-30 | 105 | 3-60 |
| 511. Selenium | 1-5 | 87 | 13-47 |
| 512. Silver | 1-3 | 103 | 6-30 |
| 513. Thallium | 1 | 96 | 5-14 |
| 514. Zinc | 6-50 | 104 | 5-45 |
| 601. Total Cyanides | 10-20 | 91 | 10-17 |
| 602. Total Phenols | 10-20 | 96 | 6-16 |

## Table A-6

## QUALITY ASSURANCE DATA

### Classical Parameters (7XX Series) Analysis*

| Compound | Spike Concentration mg/L | Mean % Recovery | Relative Standard Deviation, % |
|---|---|---|---|
| 703. Ammonia | 4.1 | 94 | 2 |
| 704. Oil and Grease | 230 | 79 | 30 |
| 705. TSS | 70 | 42 | 75 |
| 706. TOC | 75 | 102 | 2 |
| 707. COD | 190 | 75 | 16 |
| 708. BOD | 105 | 117 | 17 |

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* Data from Atlanta study - method reference standards only.

# APPENDIX B

## Total Number of Pollutant Observations in Sources - by City

The tables in this Appendix report the number of times a pollutant was observed in each city, organized by source category. Data for all of the pollutants ever detected are included, except for methylene chloride, which was excluded because of its probable presence due to contamination. A blank indicates that it was not detected in that city, or at all.

## Table B-1

## TOTAL NUMBER OF OBSERVATIONS IN TAP WATER SAMPLES

| | Cincinnati | | St. Louis | | Atlanta | | Hartford | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of Samples | 4 | | 2 | | 2 | | 4 | | | 12 |
| 104. Vinyl Chloride | | | | | | | | | | |
| 106. Chloroethane | | | | | | | | | | |
| 108. Trichlorofluoromethane | | | | | | | | | | |
| 109. Acrylonitrile | | | | | | | | | | |
| 110. 1,1-Dichloroethylene | | | | | | | | | | |
| 111. 1,1-Dichloroethane | | | | | | | | | | |
| 112. Trans-1,2-dichloroethylene | | | | | | | | | | |
| 113. Chloroform | 4 | | 2 | | 2 | | 4 | | | 12 |
| 114. 1,2-Dichloroethane | | | | | | | | | | |
| 115. 1,1,1-Trichloroethane | | | | | | | | | | |
| 116. Carbon tetrachloride | | | | | | | | | | |
| 117. Bromodichloromethane | 4 | | 2 | | 2 | | 4 | | | 12 |
| 118. 1,2-Dichloropropane | | | | | | | | | | |
| 119. Trans-1,3-Dichloropropylene | | | | | | | | | | |
| 120. Trichloroethylene | | | | | | | | | | |
| 121. Benzene | | | | | | | | | | |
| 123. Dibromochloromethane | 4 | | 2 | | 1 | | | | | 7 |
| 124. 1,1,2-Trichloroethane | | | | | | | | | | |
| 125. Bromoform | 3 | | 1 | | | | | | | 4 |
| 126. 1,1,2,2-Tetrachloroethane | | | | | | | | | | |
| 127. 1,1,2,2-Tetrachloroethylene | | | 2 | | 1 | | | | | 3 |
| 128. Toluene | | | 1 | | | | | | | 1 |
| 129. Chlorobenzene | | | | | | | | | | |
| 130. Ethylbenzene | 1 | | | | | | | | | 1 |
| 201. 2-Chlorophenol | | | | | | | | | | |
| 203. Phenol | | | | | | | | | | |
| 204. 2,4-Dimethylphenol | | | | | | | | | | |
| 205. 2,4-Dichlorophenol | | | | | | | | | | |
| 206. 2,4,6-Trichlorophenol | | | | | | | | | | |
| 207. p-Chloro-m-cresol | | | | | | | | | | |
| 210. Pentachlorophenol | | | | | | | | | | |
| 301. Dichlorobenzenes | | | | | | | | | | |
| 310. Nitrobenzene | | | | | | | | | | |
| 312. 1,2,4-Trichlorobenzene | | | | | | | | | | |
| 315. Naphthalene | | | | | | | | | | |
| 326. Diethylphthalate | 1 | | | | | | | | | 1 |
| 331. Anthracene/Phenanthrene | | | | | | | | | | |
| 333. Di-n-butylphthalate | 2 | | | | | | 1 | | | 3 |
| 334. Fluoranthene | | | | | | | | | | |
| 335. Pyrene | | | | | | | | | | |
| 337. Butylbenzylphthalate | | | | | | | | | | |
| 338. Bis (2-ethylhexyl)(di-n-octyl) phthalate | 2 | | | | | | | | | 2 |
| 404. Heptachlor | | | | | | | | | | |
| 408. Aldrin | | | | | | | | | | |
| 601. Antimony | | | 2 | | | | | | | 2 |
| 602. Arsenic | 3 | | | | | | | | | 3 |
| 604. Cadmium | 1 | | | | | | | | | 1 |
| 605. Chromium | 1 | | | | | | | | | 1 |
| 606. Copper | 3 | | 2 | | 2 | | 4 | | | 11 |
| 607. Lead | | | 2 | | 2 | | | | | 4 |
| 608. Manganese | 2 | | | | 2 | | 2 | | | 6 |
| 609. Mercury | | | | | | | | | | |
| 610. Nickel | 1 | | | | 2 | | | | | 3 |
| 611. Selenium | 2 | | | | 2 | | | | | 4 |
| 612. Silver | 1 | | | | | | | | | 1 |
| 613. Thallium | | | | | | | | | | |
| 614. Zinc | 1 | | 1 | | 2 | | 3 | | | 7 |
| 801. Total Cyanides | | | | | | | | | | |
| 802. Total Phenols | 2 | | | | | | | | | 2 |

## Table B-2

## TOTAL NUMBER OF OBSERVATIONS IN RESIDENTIAL SAMPLES

| | Cincinnati | | St. Louis | | Atlanta | | Hartford | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of Samples | 11 | | 18 | | 6 | | 12 | | | 47 |
| 104. Vinyl Chloride | | | | | | | | | | |
| 105. Chloroethane | | | | | | | | | | |
| 108. Trichlorofluoromethane | | | | | | | | | | |
| 109. Acrylonitrile | | | | | | | | | | |
| 110. 1,1-Dichloroethylene | | | | | | | | | | |
| 111. 1,1-Dichloroethane | | | | | | | | | | |
| 112. Trans 1,2-dichloroethylene | | | | | | | | | | |
| 113. Chloroform | 10[a] | | 17 | | 6 | | 9 | | | 42 |
| 114. 1,2-Dichloroethane | | | 1 | | | | | | | 1 |
| 115. 1,1,1-Trichloroethane | 3[a] | | 8 | | 2 | | 3 | | | 16 |
| 116. Carbon tetrachloride | | | | | | | | | | |
| 117. Bromodichloromethane | 1[a] | | 1 | | | | | | | 2 |
| 118. 1,2-Dichloropropane | | | | | | | | | | |
| 119. Trans 1,3-Dichloropropylene | | | | | | | | | | |
| 120. Trichloroethylene | | | 3 | | 2 | | | | | 5 |
| 121. Benzene | 1[a] | | 9 | | | | | | | 10 |
| 123. Dibromochloromethane | 1[a] | | 1 | | | | | | | 2 |
| 124. 1,1,2-Trichloroethane | | | | | | | | | | |
| 125. Bromoform | | | | | | | | | | |
| 126. 1,1,2,2-Tetrachloroethane | 1[a] | | | | | | | | | 1 |
| 127. 1,1,2,2-Tetrachloroethylene | 5[a] | | 18 | | 6 | | 7 | | | 36 |
| 128. Toluene | 5[a] | | 18 | | 4 | | 2 | | | 29 |
| 129. Chlorobenzene | 1[a] | | 2 | | | | | | | 3 |
| 130. Ethylbenzene | 4[a] | | 3 | | 1 | | | | | 8 |
| 201. 2-Chlorophenol | | | | | | | | | | |
| 203. Phenol | 7 | | 10 | | 1 | | | | | 18 |
| 204. 2,4-Dimethylphenol | 1 | | 1 | | 1 | | | | | 3 |
| 205. 2,4-Dichlorophenol | | | | | | | | | | |
| 206. 2,4,6-Trichlorophenol | | | | | | | | | | |
| 207. p-Chloro-m-cresol | | | | | | | | | | |
| 210. Pentachlorophenol | | | | | 2 | | | | | 2 |
| 301. Dichlorobenzenes | | | 6 | | | | | | | 6 |
| 310. Nitrobenzene | | | | | | | 1 | | | 1 |
| 312. 1,2,4-Trichlorobenzene | | | | | | | 1 | | | 1 |
| 315. Naphthalene | 1 | | 2 | | | | 1 | | | 4 |
| 330. Diethylphthalate | 10 | | 11 | | | | 2 | | | 23 |
| 331. Anthracene/Phenanthrene | | | 1 | | | | 1 | | | 2 |
| 333. Di-n-butylphthalate | 5 | | 8 | | 1 | | 2 | | | 16 |
| 334. Fluoranthene | | | | | | | 1 | | | 1 |
| 335. Pyrene | | | 1 | | | | | | | 1 |
| 337. Butylbenzylphthalate | 3 | | 17 | | | | 2 | | | 22 |
| 338. Bis (2-ethylhexyl)/di-n-octyl phthalate | 7 | | 4 | | | | | | | 11 |
| 404. Heptachlor | | | | | | | | | | |
| 406. Aldrin | | | 2 | | | | | | | 2 |
| 501. Antimony | 2 | | 12 | | 2 | | | | | 16 |
| 502. Arsenic | 11 | | | | | | 5[b] | | | 16 |
| 504. Cadmium | 1 | | 4 | | 1 | | 1[b] | | | 7 |
| 505. Chromium | 3 | | 18 | | 6 | | 2[b] | | | 29 |
| 506. Copper | 11 | | 18 | | 6 | | 11[b] | | | 46 |
| 507. Lead | 6 | | 18 | | 6 | | 8[b] | | | 38 |
| 508. Manganese | 11 | | 18 | | 6 | | 11[b] | | | 46 |
| 509. Mercury | 1 | | 6 | | | | 1[b] | | | 8 |
| 510. Nickel | 2 | | 18 | | 6 | | 2[b] | | | 28 |
| 511. Selenium | 6 | | 18 | | | | 2[b] | | | 26 |
| 512. Silver | 3 | | 5 | | 2 | | | | | 10 |
| 513. Thallium | | | | | | | | | | |
| 514. Zinc | 11 | | 18 | | 6 | | 11[b] | | | 46 |
| 601. Total Cyanides | | | 1 | | 1 | | | | | 2 |
| 602. Total Phenols | 10 | | 18 | | 6 | | 9 | | | 43 |

[a] 10 samples

[b] 11 samples

## Table B-3

## TOTAL NUMBER OF OBSERVATIONS IN COMMERCIAL SAMPLES

| | Cincinnati | | St. Louis | | Atlanta | | Hartford | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of Samples | 12 | | 12 | | 9 | | 9 | | | 42 |
| 104. Vinyl Chloride | | | | | | | | | | |
| 105. Chloroethane | | | | | | | | | | |
| 106. Trichlorofluoromethane | | | | | | | | | | |
| 109. Acrylonitrile | | | | | | | | | | |
| 110. 1,1-Dichloroethylene | | | 2 | | | | | | | 2 |
| 111. 1,1-Dichloroethane | | | 1 | | | | | | | 1 |
| 112. Trans-1,2-dichloroethylene | 2 | | 4 | | 3 | | 1 | | | 10 |
| 113. Chloroform | 12 | | 12 | | 9 | | 9 | | | 42 |
| 114. 1,2-Dichloroethane | 1 | | | | | | 1 | | | 2 |
| 115. 1,1,1-Trichloroethane | 7 | | 10 | | 2 | | 3 | | | 22 |
| 116. Carbon tetrachloride | | | | | 2 | | | | | 2 |
| 117. Bromodichloromethane | 9 | | 12 | | | | | | | 21 |
| 118. 1,2-Dichloropropane | | | | | | | | | | |
| 119. Trans-1,3-Dichloropropylene | | | 1 | | | | | | | 1 |
| 120. Trichloroethylene | | | | | 5 | | 1 | | | 6 |
| 121. Benzene | 8 | | 11 | | 1 | | 1 | | | 21 |
| 123. Dibromochloromethane | 6 | | 12 | | | | | | | 18 |
| 124. 1,1,2-Trichloroethane | | | | | | | | | | |
| 125. Bromoform | | | | | | | | | | |
| 126. 1,1,2,2-Tetrachloroethane | | | | | | | | | | |
| 127. 1,1,2,2-Tetrachloroethylene | 12 | | 12 | | 9 | | 8 | | | 41 |
| 128. Toluene | 12 | | 12 | | 8 | | 6 | | | 38 |
| 129. Chlorobenzene | | | 2 | | | | | | | 2 |
| 130. Ethylbenzene | 8 | | 7 | | 3 | | 3 | | | 21 |
| 201. 2-Chlorophenol | | | | | | | | | | |
| 203. Phenol | 6 | | 5 | | 3 | | 3 | | | 17 |
| 204. 2,4-Dimethylphenol | | | | | | | | | | |
| 205. 2,4-Dichlorophenol | | | | | | | | | | |
| 206. 2,4,6-Trichlorophenol | | | | | | | | | | |
| 207. p-Chloro-m-cresol | | | | | | | | | | |
| 210. Pentachlorophenol | | | | | 6 | | | | | 6 |
| 301. Dichlorobenzenes | 1 | | 9 | | 1 | | 2 | | | 13 |
| 310. Nitrobenzene | | | | | | | | | | |
| 312. 1,2,4-Trichlorobenzene | | | | | | | 1 | | | 1 |
| 315. Naphthalene | 4 | | 2 | | | | 1 | | | 7 |
| 320. Diethylphthalate | 9 | | 6 | | | | | | | 15 |
| 321. Anthracene/Phenanthrene | 1 | | | | | | | | | 1 |
| 322. Di-n-butylphthalate | 9 | | 4 | | 2 | | 3 | | | 18 |
| 324. Fluoranthene | | | | | | | | | | |
| 326. Pyrene | | | | | | | | | | |
| 327. Butylbenzylphthalate | 6 | | 11 | | 2 | | 4 | | | 23 |
| 328. Bis (2-ethylhexyl) di-n-octyl phthalate | 11 | | 3 | | 1 | | 1 | | | 16 |
| 404. Heptachlor | 2 | | | | | | | | | 2 |
| 406. Aldrin | | | | | | | | | | |
| 501. Antimony | 1 | | | | 2 | | | | | 3 |
| 502. Arsenic | 12 | | | | | | 6 | | | 18 |
| 504. Cadmium | 4 | | | | | | 1 | | | 5 |
| 505. Chromium | | | 11[a] | | 6 | | 4 | | | 21 |
| 506. Copper | 12 | | 12 | | 9 | | 9 | | | 42 |
| 507. Lead | 7 | | 12 | | 9 | | 7 | | | 35 |
| 508. Manganese | 12 | | 12 | | 9 | | 9 | | | 42 |
| 509. Mercury | 1 | | 2 | | | | 1 | | | 4 |
| 510. Nickel | 8 | | 12 | | 9 | | 6 | | | 35 |
| 511. Selenium | 6 | | 7 | | 2 | | 1 | | | 16 |
| 512. Silver | 7 | | 6 | | 5 | | 2[b] | | | 20 |
| 513. Thallium | 6 | | | | | | | | | 6 |
| 514. Zinc | 12 | | 12 | | 9 | | 9 | | | 42 |
| 601. Total Cyanides | | | 1 | | | | | | | 1 |
| 603. Total Phenols | 12 | | 11 | | 9 | | 8 | | | 40 |

a. 11 samples analyzed
b. 6 samples analyzed

# Table B-4

## TOTAL NUMBER OF OBSERVATIONS IN INDUSTRIAL SAMPLES

| | | St. Louis | | | Atlanta | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| Number of Samples | | 12 | | | 9 | | | | 21 |
| 104. | Vinyl Chloride | | | | 1 | | | | 1 |
| 105. | Chloroethane | | | | 1 | | | | 1 |
| 108. | Trichlorofluoromethane | | | | 1 | | | | 1 |
| 109. | Acrylonitrile | | | | | | | | |
| 110. | 1,1-Dichloroethylene | | | | 8 | | | | 8 |
| 111. | 1,1-Dichloroethane | | | | 7 | | | | 7 |
| 112. | Trans-1,2-dichloroethylene | 1 | | | 7 | | | | 8 |
| 113. | Chloroform | 12 | | | 9 | | | | 21 |
| 114. | 1,2-Dichloroethane | | | | 3 | | | | 3 |
| 115. | 1,1,1-Trichloroethane | 6 | | | 9 | | | | 15 |
| 116. | Carbon tetrachloride | 2 | | | 5 | | | | 7 |
| 117. | Bromodichloromethane | 12 | | | | | | | 12 |
| 118. | 1,2-Dichloropropane | | | | 1 | | | | 1 |
| 119. | Trans-1,3-Dichloropropylene | | | | | | | | |
| 120. | Trichloroethylene | 12 | | | 9 | | | | 21 |
| 121. | Benzene | 9 | | | 7 | | | | 16 |
| 123. | Dibromochloromethane | 12 | | | | | | | 12 |
| 124. | 1,1,2-Trichloroethane | | | | 1 | | | | 1 |
| 125. | Bromoform | | | | | | | | |
| 126. | 1,1,2,2-Tetrachloroethane | | | | 2 | | | | 2 |
| 127. | 1,1,2,2-Tetrachloroethylene | 12 | | | 9 | | | | 21 |
| 128. | Toluene | 12 | | | 9 | | | | 21 |
| 129. | Chlorobenzene | | | | 3 | | | | 3 |
| 130. | Ethylbenzene | 7 | | | 9 | | | | 16 |
| 201. | 2-Chlorophenol | 1 | | | 1 | | | | 2 |
| 203. | Phenol | 3 | | | 8 | | | | 11 |
| 204. | 2,4-Dimethylphenol | | | | 8 | | | | 8 |
| 205. | 2,4-Dichlorophenol | 1 | | | 1 | | | | 2 |
| 206. | 2,4,6-Trichlorophenol | 1 | | | 1 | | | | 2 |
| 207. | p-Chloro-m-cresol | | | | | | | | |
| 210. | Pentachlorophenol | | | | 4 | | | | 4 |
| 301. | Dichlorobenzenes | 8 | | | 4 | | | | 12 |
| 310. | Nitrobenzene | | | | | | | | |
| 312. | 1,2,4-Trichlorobenzene | | | | | | | | |
| 315. | Naphthalene | 7 | | | 6 | | | | 13 |
| 326. | Diethylphthalate | | | | | | | | |
| 331. | Anthracene/Phenanthrene | | | | 3 | | | | 3 |
| 333. | Di-n-butylphthalate | 8 | | | 4 | | | | 12 |
| 334. | Fluoranthene | | | | | | | | |
| 335. | Pyrene | | | | | | | | |
| 337. | Butylbenzylphthalate | 5 | | | 6 | | | | 11 |
| 338. | Bis (2-ethylhexyl)/di-n-octyl phthalate | | | | 5 | | | | 5 |
| 404. | Heptachlor | | | | | | | | |
| 408. | Aldrin | | | | | | | | |
| 501. | Antimony | 6 | | | NA | | | | 6* |
| 502. | Arsenic | 5 | | | 4 | | | | 9 |
| 504. | Cadmium | 4 | | | 4 | | | | 8 |
| 505. | Chromium | 12 | | | 9 | | | | 21 |
| 506. | Copper | 12 | | | 9 | | | | 21 |
| 507. | Lead | 12 | | | 9 | | | | 21 |
| 508. | Manganese | 12 | | | 9 | | | | 21 |
| 509. | Mercury | | | | 7 | | | | 7 |
| 510. | Nickel | 12 | | | 9 | | | | 21 |
| 511. | Selenium | 3 | | | | | | | 3 |
| 512. | Silver | 9 | | | 9 | | | | 18 |
| 513. | Thallium | 1 | | | | | | | 1 |
| 514. | Zinc | 12 | | | 9 | | | | 21 |
| 601. | Total Cyanides | 7 | | | 9 | | | | 16 |
| 602. | Total Phenols | 12 | | | 9 | | | | 21 |

* Out of 12 samples.

## Table B-5

## TOTAL NUMBER OF OBSERVATIONS IN INFLUENT SAMPLES

| | | Cincinnati | | St. Louis | | Atlanta | | Hartford | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of Samples | | 6 | | 6 | | 3 | | 3 | | | 18 |
| 104. | Vinyl Chloride | | | | | | | | | | |
| 106. | Chloroethane | | | | | | | | | | |
| 108. | Trichlorofluoromethane | | | | | 1 | | | | | 1 |
| 109. | Acrylonitrile | | | | | 1 | | | | | 1 |
| 110. | 1,1-Dichloroethylene | | | 1 | | 2 | | | | | 3 |
| 111. | 1,1-Dichloroethane | | | 1 | | | | | | | 1 |
| 112. | Trans-1,2-dichloroethylene | | | 2 | | 3 | | | | | 5 |
| 113. | Chloroform | 6 | | 6 | | 3 | | 3 | | | 18 |
| 114. | 1,2-Dichloroethane | 1 | | | | 1 | | | | | 2 |
| 115. | 1,1,1-Trichloroethane | 2 | | 6 | | 3 | | 3 | | | 14 |
| 116. | Carbon tetrachloride | | | | | | | | | | |
| 117. | Bromodichloromethane | | | 2 | | | | | | | 2 |
| 118. | 1,2-Dichloropropene | | | | | | | | | | |
| 119. | Trans-1,3-Dichloropropylene | | | | | | | | | | |
| 120. | Trichloroethylene | | | 6 | | 3 | | 3 | | | 12 |
| 121 | Benzene | 6 | | 6 | | | | | | | 12 |
| 123. | Dibromochloromethane | | | 4 | | | | | | | 4 |
| 124. | 1,1,2-Trichloroethane | | | | | | | | | | |
| 125. | Bromoform | | | | | | | | | | |
| 126. | 1,1,2,2-Tetrachloroethane | 1 | | | | | | | | | 1 |
| 127. | 1,1,2,2-Tetrachloroethylene | 3 | | 6 | | 3 | | 3 | | | 15 |
| 128. | Toluene | 2 | | 6 | | 3 | | 3 | | | 14 |
| 129. | Chlorobenzene | | | 1 | | | | | | | 1 |
| 130. | Ethylbenzene | 3 | | 6 | | 3 | | | | | 12 |
| 201. | 2-Chlorophenol | | | | | | | | | | |
| 203. | Phenol | | | 4 | | 2 | | | | | 6 |
| 204. | 2,4-Dimethylphenol | | | | | 2 | | | | | 2 |
| 205. | 2,4-Dichlorophenol | | | | | | | | | | |
| 206. | 2,4,6-Trichlorophenol | | | | | | | | | | |
| 207. | p-Chloro-m-cresol | | | | | | | 1 | | | 1 |
| 210. | Pentachlorophenol | 1 | | | | 3 | | | | | 4 |
| 301. | Dichlorobenzenes | | | 5 | | 2 | | 3 | | | 10 |
| 310. | Nitrobenzene | | | | | | | | | | |
| 312. | 1,2,4-Trichlorobenzene | | | | | | | | | | |
| 316. | Naphthalene | 2 | | 4 | | 2 | | | | | 8 |
| 328. | Diethylphthalate | 4 | | 3 | | 1 | | 1 | | | 9 |
| 331. | Anthracene/Phenanthrene | | | | | | | | | | |
| 333. | Di-n-butylphthalate | 4 | | 6 | | 1 | | 1 | | | 12 |
| 334. | Fluoranthene | | | | | | | | | | |
| 336. | Pyrene | | | | | | | | | | |
| 337. | Butylbenzylphthalate | | | 5 | | 3 | | | | | 8 |
| 338. | Bis (2-ethylhexyl)/di-n-octyl phthalate | 2 | | 2 | | | | | | | 4 |
| 404. | Heptachlor | 1 | | | | | | | | | 1 |
| 408. | Aldrin | | | | | | | | | | |
| 501. | Antimony | | | 6 | | 1 | | | | | 7 |
| 502. | Arsenic | 6 | | | | | | 2 | | | 8 |
| 504. | Cadmium | 4 | | 4 | | 2 | | | | | 10 |
| 505. | Chromium | 4 | | 6 | | 3 | | 3 | | | 16 |
| 506. | Copper | 6 | | 6 | | 3 | | 3 | | | 18 |
| 507. | Lead | 4 | | 6 | | 3 | | 3 | | | 16 |
| 508. | Manganese | 6 | | 6 | | 3 | | 3 | | | 18 |
| 509. | Mercury | 1 | | 1 | | 1 | | | | | 3 |
| 510. | Nickel | 3 | | 6 | | 3 | | 3 | | | 15 |
| 511. | Selenium | 3 | | 2 | | | | | | | 5 |
| 512. | Silver | 6 | | 6 | | 3 | | 2 | | | 17 |
| 513. | Thallium | | | | | | | | | | |
| 514. | Zinc | 6 | | 6 | | 3 | | 3 | | | 18 |
| 601. | Total Cyanides | 4 | | 5 | | 1 | | 1 | | | 11 |
| 602. | Total Phenols | 6 | | 6 | | 3 | | 3 | | | 18 |

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